MAY 7 1928

The Engineer.

Established 1856. Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C. 2.

VOL. CXLV.—No. 3773] LONDON: FRIDAY EVENING, MAY 4, 1928 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.
ARRANGED FOR CARD INDEXING.

An American Experimental Arch Dam. (P. 478)
THE ENGINEER, 4 - 5 - 28.

New Aerodrome at Croydon. (P. 493)
THE ENGINEER, 4 - 5 - 28.

Development of the Locomotive—No. IV. (P. 481)
THE ENGINEER, 4 - 5 - 28.

Electrical Equipment of the Singapore Floating Dock. (P. 486)
(E. T. WILLIAMS.) THE ENGINEER, 4 - 5 - 28.

Wire Ropes Research. (P. 495)
(W. A. SCOBLE.) THE ENGINEER, 4 - 5 - 28.

The Kitson-Still Locomotive. (P. 484)
THE ENGINEER, 4 - 5 - 28.

The Basic Open Hearth Process. (P. 482)
(B. TALBOT.) THE ENGINEER, 4 - 5 - 28.

Diesel Engines for Peak Loads. (P. 496)
(M. GERCKE.) THE ENGINEER, 4 - 5 - 28.

A New Traffic Signal. (P. 498)
THE ENGINEER, 4 - 5 - 28.

A New Vertical Milling Machine. (P. 494)
THE ENGINEER, 4 - 5 - 28.

INDEX TO ADVERTISEMENTS, PAGE 83.

PUBLIC NOTICES

HEATING.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Thursday, 17th May, 1928, for LOW-PRESSURE HOT WATER HEATING at Durham Head Post Office. Drawings, specification, a copy of the conditions and form of contract, bills of quantities and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 8367

The Director-General, India Store Department, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—
SCHEDULE 1.—SIX BOGIE OPEN WAGONS, 2ft. 6in. gauge.
SCHEDULE 2.—WHEELS and AXLES for LOCOMOTIVES.
Tenders due on the 22nd May, 1928, for No. 1, and on the 1st June, 1928, for No. 2.
Forms of Tender obtainable from the above at a fee (which will not be returned) of 5s. for each Schedule. 8431

Applications are Invited for the APPOINTMENT of CHIEF INSPECTOR OF LIGHT-HOUSES in British India.
Candidates must be Civil Engineers of proved ability, who have had extensive experience of all branches of lighthouse engineering, both structural and mechanical, and who possess a good knowledge of wireless transmission and reception. Age should not be more than 40 years. Agreement for five years with prospect of the offer of permanent employment at the end of that period if found suitable in all respects. Pay at the rate of Rs. 2000 per month, rising by annual increments of Rs. 125 per month to Rs. 2500 per month. Provident Fund. Free first-class passage to India. Strict medical examination.
Further particulars and forms of application may be obtained upon request by postcard to the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 26th May, 1928. 8359

Assistant Engineer Required by the RAILWAY DEPARTMENT of the FEDERATED MALAY STATES GOVERNMENT for four years' service, with possible extension. Salary 400 dollars, rising to 475 dollars a month by annual increments of 25 dollars a month and thereafter in the event of the officer being retained rising to 800 dollars a month, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but the purchasing power of the dollar in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax is at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 30, preferably unmarried, must have received a good theoretical training, preferably at a University or a College recognised by the Institution of Civil Engineers and possess a Civil Engineering Degree or obtained such other Diploma or Distinction in Engineering as the Secretary of State may decide in any particular case, or completed their articles with a civil engineer of good standing and have passed the examination for Associate Membership of the Institution of Civil Engineers. Should have had at least one year's practical experience of Railway Maintenance on a British railway.—Apply at once by letter, giving brief details of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, mentioning this paper and quoting clearly at head of application M/15162. 8425

Engineer Cadet Required by the RAILWAY DEPARTMENT of the FEDERATED MALAY STATES GOVERNMENT for 2 years' service in the first instance. Salary dollars 350 a month for the first year and dollars 375 a month for the second year, plus a temporary and non-pensionable allowance of 10 per cent. In the event of the officer's service being entirely satisfactory he may be offered a further agreement as Assistant Engineer upon the scale dollars 400 a month, rising to dollars 800 a month by annual increments of dollars 25 a month, with prospect of permanent and pensionable employment. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but the purchasing power of the dollar in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax is at present imposed. Free passage provided. Candidates, age 22 to 25, unmarried, must have (a) received a good theoretical training at a University or College and have passed the examination qualifying him for Associate Membership of the Institution of Civil Engineers or hold an Engineering Degree or Diploma recognised as granting exemption from Sections A and B of the A.M.I.C.E. examination, or (b) completed his articles with a civil engineer of good standing and have passed the A.M.I.C.E. examination.—Apply at once by letter, giving particulars of age, qualifications and practical experience (if any), to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/15162A. 8426

Assistant Storekeeper REQUIRED by the GOVERNMENT of HONG KONG for the PUBLIC WORKS DEPARTMENT for three years' service, with possible permanency. Salary £400 a year, rising by annual increments of £10 to £420 a year and thereafter rising to £550 a year by annual increments of £10 in the event of the appointment being made permanent. Salary payable locally in dollars under a compensation scheme at present in force at a favourable rate of exchange. Free passages and quarters or an allowance in lieu. Candidates, aged 24 to 30, preferably unmarried, should have received their training in the Stores Department of a Railway Company or large industrial concern and be thoroughly conversant with both the storekeeping and accounting branches of a Stores Department. They should have an extensive knowledge of the nomenclature and use of engineering and building stores and be familiar with manufacturers' descriptions and methods of invoicing.—Apply at once by letter, stating age, particulars of experience, whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/583. 8365

Assistant Engineers (22) REQUIRED by the GOVERNMENT of NIGERIA for the PUBLIC WORKS DEPARTMENT for two tours of not less than 12 nor more than 18 months' service in the first instance. Subject to satisfactory service, the officers appointed will be eligible at the expiration of three years' service for confirmation in the permanent and pensionable establishment. The foregoing officers are required to fill vacancies caused by the increase of the establishment of the Nigeria Public Works Department. Salary £480 a year for the first three years, then £510, rising by annual increments to £920. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates must have attained the age of 21½ years on the date of appointment, and should preferably have attained the age of 22½ and must not be over 35 years of age. Must have obtained an Engineering Degree at a recognised University or have passed Sections "A" and "B" of the A.M.I.C.E. Examination or have passed the Associateship in Civil Engineering of the City and Guilds Institute, or possess such other Degree or Diploma or Distinction in Engineering as may be considered satisfactory. Candidates whose qualifying Diplomas have been obtained without a College course should have had three years' practical experience of Civil Engineering under a qualified civil engineer. It is preferred that all candidates should have had two years' practical experience on good engineering work, subsequent to taking their degree or completing their articles, but under certain conditions this may be waived in the case of candidates in possession of an Engineering Degree.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, S.W. 1, quoting M/254. 8397

Civil Engineers (2) Required by the GOVERNMENT of CEYLON for three years' service as DISTRICT ENGINEERS in the PUBLIC WORKS DEPARTMENT. Salary £500, rising to £960 a year by annual increments (a commencing salary of £600 a year in the foregoing scale will be paid to selected candidates who have attained the age of 30.) Free passages. Candidates, aged between 25 and 35, should have passed the examination to qualify for Associate Membership of the Institution of Civil Engineers and have held post as Contractor's Engineer or as Resident Engineer on Public Works with experience in costing and accounting. Must be competent in engineering surveying and setting out, and in levelling.—Apply at once in writing, giving age, qualifications and experience, and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/626. 8363

Civil Service Commission. FORTHCOMING EXAMINATION.
MALE CARTOGRAPHERS in the Hydrographic Department of the Admiralty (19-25, with extension in certain cases). Regulations and particulars are obtainable from the SECRETARY, Civil Service Commission, Burlington-gardens, London, W. 1, together with the form on which application must be made. The latest date for the receipt of application forms is 24th May. 8321

Civil Service Commission. FORTHCOMING EXAMINATION.
PROBATIONARY ASSISTANT ENGINEERS in the Engineering Department of the Post Office (20-23, with extension in certain cases). Regulations and particulars are obtainable from the SECRETARY, Civil Service Commission, Burlington-gardens, London, W. 1, together with the form on which application must be made. The latest date for the receipt of application forms is 26th July. 8380

Civil Service Commission. FORTHCOMING EXAMINATION.
PROBATIONARY INSPECTORS in the Engineering Department of the Post Office (17-20, with extension for service in H.M. Forces). Regulations and particulars are obtainable from the SECRETARY, Civil Service Commission, Burlington-gardens, London, W. 1, together with the form on which application must be made. The latest date for the receipt of application forms is 12th July. 8366

Technical Instructor REQUIRED by the GOVERNMENT of NIGERIA for the MARINE DEPARTMENT, to organise and supervise the training of African apprentices in mechanical engineering, for two tours of 12 to 18 months, with possible extension. Salary £600 a year, rising by annual increments to £920 a year. Outfit allowance of £60 on first appointment. Free quarters and passages, liberal leave on full salary. Candidates, aged 28 to 40, should have had experience in Marine Engineering, Workshops and Drawing-office. Preference will be given to those possessing Engineering Degrees.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/445. 8364

PUBLIC NOTICES

Accountant Required by the GOVERNMENT of the TANGANYIKA TERRITORY for the PUBLIC WORKS DEPARTMENT for a tour of 20 to 30 months' service. Salary £480 a year. Outfit allowance of £30 on first appointment. Free passages, quarters and liberal leave on full salary. Candidates, aged 25 to 45, must be unmarried. They must also be qualified Accountants, preferably with experience on engineering works and of costing, storekeeping and general accounting.—Apply at once by letter, stating age, qualifications and particulars of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank Westminster, S.W. 1, quoting M/638. 8362

Assistant Engineer Required by the LAGOS TOWN COUNCIL, NIGERIA, for two tours of 12 to 18 months' service, with prospect of extension. Salary £510, rising by annual increments to £720 a year. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, aged 25 to 35, should be A.M.I.C.E. or hold the Testamur of the Institution of Municipal and County Engineers or other approved diploma. Must have had a good office training in a Municipal Engineer's office, be good Surveyors and have had experience in Drainage, Town Planning and other Municipal Works. Acknowledge of valuation and assessment of properties will be an advantage.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/554. 8430

Armstrong College,
NEWCASTLE-UPON-TYNE.
(IN THE UNIVERSITY OF DURHAM.)

COURSES for the PASS DEGREE of B.Sc. and the HONOURS DEGREE of B.SC. in MECHANICAL, MARINE, CIVIL or ELECTRICAL ENGINEERING, MINING, METALLURGY, or NAVAL ARCHITECTURE. The curricula of the Pass Degree and the Honours Degree normally occupy periods of three and four years respectively, but candidates presenting evidence of sufficient previous training may be allowed to proceed to either Degree after two years' residence.

The engineering laboratories have recently been extended, and all Departments are equipped for advanced tutorial and research work.

Full particulars of the Courses may be had on application to

THE REGISTRAR,
Armstrong College,
7059 Newcastle-upon-Tyne.

MANCHESTER MUNICIPAL
COLLEGE OF TECHNOLOGY.
UNIVERSITY OF MANCHESTER.
(FACULTY OF TECHNOLOGY).
PRINCIPAL: B. MOUAT JONES, D.S.O., M.A.

EDMUND MILLS HARWOOD MEMORIAL SCHOLARSHIP.

The Governing Body announce the offer of a Scholarship of the value of £50 per annum for three years, tenable in one of the University Engineering Courses in the College of Technology.
Forms of nomination and all information may be obtained on application to the REGISTRAR of the College.
Applications must be received on or before 15th June. 8378

North-East Coast Institution OF ENGINEERS AND SHIPBUILDERS.

GEORGE MITCHELL HARROWAY SCHOLARSHIP.

ENTRIES are INVITED for the GEORGE MITCHELL HARROWAY SCHOLARSHIP. These should be addressed, not later than the 1st June, to the undersigned, from whom full particulars of the Scholarship may be obtained.
The Scholarship is of the value of £100 and is tenable for three years at one of the Universities at which Shipbuilding and Marine Engineering subjects are taken.
Candidates must be natives of Blyth or Middlesbrough, of not less than 17 nor more than 19 years of age, and have served at least one year of an apprenticeship in shipbuilding or marine engineering.
There will be no examination in specific subjects, but candidates who fulfil the Scholarship regulations will be required to present themselves for interview by the Selection Committee.
E. W. FRASER-SMITH,
Secretary.
Bolbec Hall, Newcastle-upon-Tyne. 8368
26/4/28.

PUBLIC NOTICES (continued) Page 2.
SITUATIONS OPEN, Pages 2 and 4.
SITUATIONS WANTED, Page 4.
AUCTIONS, Page 84.
BUSINESSES and PREMISES (For Sale, etc.). Page 84.
EDUCATIONAL, Page 4.
MACHINERY, &c., WANTED, Page 4.
PATENTS, Page 4.
PARTNERSHIPS, Page 4.
AGENCIES, Page 4.
MISCELLANEOUS, Page 4.
FOR SALE, Pages 4, 78 and 84.
FOR HIRE, Page 84.
WORK WANTED, Page 4.

For Advertisement Rates see Leader Page.

PUBLIC NOTICES

Battersea Borough Council.

PROPOSED "SOUTHLANDS" PUBLIC WASH-HOUSE.

The Council invite TENDERS for the SUPPLY and ERECTION of the FOLLOWING PLANT :—

(a) TWO VERTICAL WATER-TUBE BOILERS, each constructed for a daily working pressure of 100 lb., and when fired with good quality gas house coke, capable of evaporating as a maximum 3000 lb. of water per hour with cold feed.

(b) VERTICAL WATER-SOFTENING PLANT, capable of dealing with a maximum of 2000 gallons of water per hour, this water to be heated in the plant from 60 deg. Fah. to 120 deg. Fah.

(c) GILLED PIPE ECONOMISER, capable of heating 2000 gallons of water per hour from 120 deg. Fah. to 200 deg. Fah.

(d) 7000 Gallons PRESSED STEEL COLD WATER STORAGE TANK.

(e) 1000 Gallons HOT WATER CYLINDER.

Forms of Tender, containing full particulars, may be obtained at the Town Hall, Lavender Hill, S.W. 11, between 10 a.m. and 4 p.m. (Saturday, 10 a.m. to 1 p.m.).

Tenders, in separate envelopes, sealed and marked on the outside "Tender for.....," must be delivered to me by 10 a.m. on Saturday, 19th May, 1928.

The Council do not bind themselves to accept the lowest or any Tender, and they reserve to themselves the right to accept the whole or any portion of a Tender.

EDWIN AUSTIN,
Town Clerk.

Town Hall, Battersea, S.W. 11,
2nd May, 1928. 8410

Bengal-Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for :—

A.—6615 DRAW-BARS.

B.—WROUGHT IRON, STEEL, AND OTHER FITTINGS FOR CARRIAGES.

C.—GUN-METAL, LAVATORY AND OTHER FITTINGS FOR CARRIAGES.

Specifications and forms of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after 27th April, 1928.

A fee of 20s. will be charged for Specification A, and 10s. each for Specifications B and C, which is NOT returnable.

Tenders must be submitted not later than Noon on Thursday, 10th May, 1928, for Specification A, and not later than Noon on Friday, 11th May, 1928, for Specifications B and C.

The Directors do not bind themselves to accept the lowest or any Tenders, and reserve to themselves the right of reducing or dividing the orders.

By Order of the Board,
R. C. VOLKERS,
Secretary.

27th April, 1928. 8377

Bengal-Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for—

TEN THROUGH SPAN GIRDER BRIDGES (150ft. span).

Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after 3rd May, 1928.

A fee of 20s. will be charged for each specification, which is NOT returnable.

Tenders must be submitted not later than NOON on Wednesday, 16th May, 1928.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.

By Order of the Board,
R. C. VOLKERS,
Secretary.

3rd May, 1928. 8424

Borough of Colchester.

The Corporation invite TENDERS for WORKS in connection with proposed Extensions to the Electricity Supply Undertaking as follows :—

CONTRACT No. 15.—One 250 kVA, 6600/400-volt, Three-phase Transformer; One 11,000-volt E.H.T. Switch Cubicle; One 400-ampere and Four 300-ampere, 650-volt, L.T., Cast Iron draw-out pillar type Oil Circuit Breakers and Cable Connections supplied and erected.

CONTRACT No. 16.—About 2450 Yards Four-core L.T. Three .20, and One .175 sq. in.; 1600 Yards Four-core Three .150 and One .10 sq. in.; and 1400 Yards Four-core Three .10 and One .075 sq. in. Cables, supplied, laid and jointed, and Road Work.

Persons desiring to Tender must communicate their intention to Mr. W. C. C. Hawtayne, Consulting Engineer, 9, Queen Street-place, London, E.C. 4, on or before the 10th instant.

Persons tendering are at liberty to Tender for one or both contracts.

Tenders for part of one contract or for supply and delivery only will not be considered bona fide Tenders.

Specifications and plans will be issued on or about the 16th instant to persons who have complied with the above requirement and who after receiving notice from the Consulting Engineer send to the Town Clerk, Colchester, a deposit of Two Pounds in Treasury notes for each specification applied for. The deposit will be returnable on receipt of a bona fide Tender on or before the prescribed date.

Extra copies of the specification can be obtained by remitting Half-a-Guinea for each copy, which amount will not be returnable.

Tenders, sealed and endorsed "Electricity Supply, Lexden Extensions, Contract No. ....," to be delivered to the undersigned on or before Twelve o'clock Noon on the 30th May, 1928.

The Corporation do not bind themselves to accept the lowest or any Tender.

R. L. H. HISCOTT,
Town Clerk.

Town Hall, Colchester,
1st May, 1928. 8381

PUBLIC HEALTH ACT, 1875.

Urban District of Ruislip-Northwood, MIDDLESEX.

CONTRACT NO. 2.

TO MACHINERY CONTRACTORS.

The Urban District Council of Ruislip-Northwood, acting as the Sanitary Authority for the said District, are prepared to receive TENDERS for PUMPING MACHINERY, &c. The works will comprise Cold-starting Crude Oil Engines and Centrifugal Pumps, together with Ancillary Works, to be installed in the Pump Well and Engine-house at the Ruislip Sewage Works.

Particulars and specification may be obtained at the offices of the Consulting Engineers, Messrs. Howard Humphreys and Sons, 28, Victoria-street, Westminster, on and from Tuesday, the 8th of May, until Friday, the 18th of May, between the hours of 10 a.m. and 4 p.m., upon payment of a deposit of Three Guineas, which deposit will be returned upon receipt of a bona fide Tender which is not subsequently withdrawn by the contractor.

The successful tenderer will be required to execute a contract and bond in a form to be prepared by the undersigned.

Tenders must be on the official form, each Tender in a sealed envelope marked "Tender for Ruislip Machinery." Tenders must be accompanied by the general conditions and specification as issued by the Consulting Engineers.

Each Tender must be signed in the handwriting of the tenderer or his authorised agent.

The Council does not bind itself to accept the lowest or any Tender.

Tenders must reach the undersigned by 9 a.m. on Friday, the 1st of June, 1928.

Given under my hand the 30th day of April, 1928.

EDMUND R. ABBOTT,
Clerk to the Ruislip-Northwood U.D.C.

Council Offices,
Northwood, Middlesex. 8382

PUBLIC NOTICES

HALIFAX.

County Borough of Halifax.

The Corporation are prepared to receive TENDERS for the SUPPLY and ERECTION of a WATER FILTRATION PLANT.

Particulars, conditions and form of Tender may be obtained from E. P. Brook, Waterworks Engineer, on and after Monday, the 7th of May, 1928, on payment of the sum of One Guinea, which will be refunded on receipt of a bona fide Tender.

Tenders, sealed and endorsed "Tender for Mechanical Filters, Halifax Water Supply," to be delivered to my office not later than Twelve Noon on Thursday, the 31st of May, 1928.

The Corporation do not bind themselves to accept the lowest or any Tender.

PERCY SAUNDERS,
Town Clerk.

Town Hall, Halifax,
1st May, 1928. 8409

Liverpool Corporation Waterworks.

VYRNWY SUPPLY.

NEW FILTER BEDS, OSWESTRY.

The Water Committee of the Liverpool Corporation invite TENDERS for the CONSTRUCTION of FOUR FILTER BEDS at Oswestry in the County of Salop.

Plans may be inspected and copies of the specification and forms of Tender obtained at the Water Engineer's Office, 55, Dale-street, Liverpool, upon payment of the sum of Five Guineas, which amount will be returned upon receipt of a bona fide Tender.

Tenders to be received not later than Twelve o'clock Noon on Monday, the 21st May, 1928.

The Water Committee do not bind themselves to accept the lowest or any other Tender.

WALTER MOON,
Town Clerk.

Municipal Buildings, Liverpool,
May, 1928. 8418

Loch Leven Pier Company, LIMITED.

KINLOCHLEVEN WHARF, ARGYLLSHIRE.

The Loch Leven Pier Company, Limited, are prepared to receive TENDERS for the REMOVAL of a PORTION of the above WHARF and its PARTIAL RECONSTRUTCION in Reinforced Concrete, in accordance with specification and drawings prepared by their Consulting Engineers, Messrs. C. S. Meik and Buchanan, 16, Victoria-street, Westminster, S.W. 1.

The drawings may be seen and a copy of the specification and a form of Tender obtained at the offices of the British Aluminium Co., Ltd., 45, Hope-street, Glasgow, C. 2, or of the Consulting Engineers, upon the payment by cheque only of the sum of Five Guineas, which will be returned on receipt of a bona fide Tender.

Sealed Tenders, addressed to the Secretary, Loch Leven Pier Company, Limited, Adelaide House, King William-street, London, E.C. 4, must be received before mid-day on Monday, 21st May, 1928.

The Company do not bind themselves to accept the lowest or any Tender.

G. W. JEFFERY,
Secretary.

8421

Manchester Corporation.

The Rivers Committee invite TENDERS for the CONSTRUCTION of MAIN DRAINAGE WORK No. 13 (NEW SEWER from Rochdale-road, along Factory-lane and Waterloo-street to Todd's-place, Lower Crumpsall).

Plans may be seen and specifications, bills of quantities and forms of Tender obtained on application at the City Engineer's Office, Town Hall, Manchester, on payment to the City Treasurer of £5 5s., which sum will, after the Corporation have come to a decision upon the Tenders received, but not before, be returned to the person submitting a bona fide Tender.

All cheques or postal orders are to be made payable to the order of "The Corporation of Manchester."

Tenders, enclosed in the official envelope and addressed to the Chairman of the Rivers Committee, are to be delivered at the City Engineer's Office not later than 9.30 a.m. on Friday, the 18th May, 1928.

The Corporation do not bind themselves to accept the lowest or any Tender.

P. M. HEATH,
Town Clerk.

Town Hall, Manchester,
23rd April, 1928. 8342

South Indian Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

RAILWAY TICKETS.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Railway Tickets," must be left with the undersigned not later than Twelve Noon on Friday, 18th May, 1928.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 5s. for each copy of the specification.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W. 1,
4th May, 1928. 8428

State Electricity Commission

OF VICTORIA,
22-32, WILLIAM-STREET, MELBOURNE, AUSTRALIA.

Separate TENDERS are hereby INVITED for the MANUFACTURE, SUPPLY and DELIVERY of SWITCHGEAR for the Yallourn Power Scheme, as follows :—

(A) SPECIFICATION No. 28/20.—120,000 V. Switchgear for Richmond Terminal Station.

(B) SPECIFICATION No. 28/21.—135,000 V. Switchgear for Yallourn Power Station Extension.

Copies of Tender form, specification, &c., will be available upon application to the Agent-General for Victoria, Victoria House, Strand, London.

Charge for specification in each case £1 1s. for three copies of Tender form, conditions of contract and specification complete, returnable under certain conditions as specified in the general conditions of tendering. Extra copies 10s. 6d. each, not returnable.

A preliminary deposit of £100 is to be lodged with Tender in each case.

Tenders, on prescribed form, properly endorsed and addressed, must be delivered at the office of the Commission, Melbourne, not later than 3rd September, 1928.

The Commission does not bind itself to accept the lowest or any Tender.

R. LIDDELOW,
Secretary.

8250

The Derwent Valley Water Board.

SECOND PIPE TO AMBERGATE.

The Derwent Valley Water Board is prepared to receive TENDERS for the LAYING of about 15,000 YARDS of 47in. STEEL PIPES, lined with hydrocarbon, and FIXING of VALVES, and CONSTRUCTION of VALVE CHAMBERS, &c., in connection therewith.

The specification, schedule of prices, and copies of the drawings may be obtained on application to Mr. S. B. Winser, M. Inst. C.E., Engineer to the Board, at these offices, on and after Monday, April 30th, on payment of Five Guineas, which will be returned on receipt of a bona fide Tender and the documents furnished by him.

Sealed Tenders, enclosed in the envelopes supplied with the documents, to be delivered not later than Nine o'clock on Saturday Morning, the 19th May.

The Board will not be bound to accept the lowest or any Tender.

O. B. STEWARD,
Clerk to the Board.

Bamford, near Sheffield,
27th April, 1928. 8300

PUBLIC NOTICES

Abertillery and District WATER BOARD.

SALE OF PLANT.

The above Board offer FOR SALE extensive ELECTRICAL, STEAM and other PLANT recently used in the construction of a large concrete masonry dam.

The following are some of the principal items :—

Generating Plant, consisting of No. 2 Ruston and Hornsby 220 H.P. Gas Engines and Producer Plants with No. 2 Metropolitan Vickers 150 kW, 500 v. Dynamos.

No. 1 100 H.P. National Gas Engine and Producer Plant with No. 1 Bruce Peebles 100 kW, 500 v. Dynamo.

No. 4 Anderson-Grice 2-Ton, 3-Motor Electric Loco. Cranes.

No. 4 Steam Derrick Cranes, 4 and 5-Ton.

No. 1 Ingersoll-Rand Air Compressor, 14in. by 12in., with 500-volt Motors.

No. 1 Double Concrete Hoist, 180ft. high, by Stothert and Pitt, with Trussed Steel Chutes, Hoisting Winches, 4-Yard Mixers, and 500-v. Motors.

No. 7 Steam Locomotives, 3ft. gauge.

No. 1 5-Ton Cableway, by Henderson, 1100ft. span, Luffing Head Masts, electrically driven.

50 Tons 56 lb. F.B. Rails with Fish-plates.

Further particulars can be obtained from the Board's Engineer, Mr. J. FRANCIS JUPP, M. Inst. C.E., Midland Bank Chambers, Newport, Mon. 8264

County Borough of South Shields.

ELECTRICITY SUPPLY DEPARTMENT.

The Corporation have FOR SALE the following SURPLUS PLANT :—

2 Steam-driven D.C. Generators with Spare Armature for same.
3 Steam-driven Single-phase Alternators.
2 "Worthington" Duplex Feed Water Pumps.
2 "Weir" Feed Water Pumps.
1 "Weir" Service Pump.
1 "Allen" Condensing Plant.

Particulars of the above plant, together with form of Tender and conditions of purchase, can be had on application to the BOROUGH ELECTRICAL ENGINEER, 10, Albion-terrace, South Shields. 8330

Administrative County of LONDON.

The London County Council invites APPLICATIONS for an APPOINTMENT in the First Class (Technical) in the major establishment in the CHIEF ENGINEER'S DEPARTMENT. The salary is £250, rising by £15 annually to £310 a year, thence by £20 annually to £350 a year, and is subject to temporary additions, the total minimum and maximum remuneration at the present time being £361 2s. 6d. and £485 7s. 1d. respectively. There are prospects of promotion.

Candidates must be not less than 25 years and not more than 35 years of age on 31st May, 1928, unless already in the Council's service. They must have been fully trained as mechanical engineers and possess thorough practical experience in the design, construction and maintenance of large pumping plant and hydraulic machinery, including steam engines and boiler plant and internal combustion engines, and also of mechanical engineering appliances and apparatus generally. Some experience in marine engineering workshops would be an advantage.

Candidates who are not Corporate Members of the Institution of Civil Engineers or of the Institution of Mechanical Engineers must hold an equivalent Engineering Degree or Diploma by examination.

Applications must be made on the official form, copies of which (with full particulars) may be obtained by sending a stamped addressed foolscap envelope (marked "Technical Assistant") to the Clerk of the Council, The County Hall, Westminster Bridge, S.E. 1.

Forms must be returned by Thursday, 31st May, 1928. Canvassing disqualifies.

MONTAGU H. COX,
Clerk of the London County Council.
8402

Applications are Invited (by letter only from properly qualified candidates as TRANSMISSION LINE ENGINEER,

who must be thoroughly qualified in reconnaissance work, control of survey and construction of high-tension overhead transmission lines. Age about 30 to 38 years, unmarried man preferred. Salary £800 to £900 per annum, according to age and qualifications. First-class free passage to Malaya and home again on satisfactory termination of services. The selected candidate will be required to pass a strict medical examination before appointment. Applicants must give particulars of their general and technical education and a detailed record of their practical training and subsequent experience with dates in each case, names of employers from time to time and the class of work carried out, together with copies only of testimonials, which cannot be returned. Letters should be addressed to the undersigned not later than 11th May, 1928.

RENDEL, PALMER & TRITTON,
Appointments Department,
8403 13, Dartmouth-street, Westminster, S.W.1.

Madras and Southern Mahratta RAILWAY.

PRODUCTION ENGINEER AND STAFF.

REQUIRED for service on the Madras and Southern Mahratta Railway at Perambur, India, the following :

PRODUCTION ENGINEER (Official Grade), age 30 to 35 years. Candidates must have held a responsible administrative position, such as Production Engineer or Head Planner and Rate Fixer in a Railway Locomotive Workshop or Locomotive Builder's Shops, and must thoroughly understand the organisation of a large works system and lay-out, and be able to initiate and control planning, rate fixing, progress, inspection and costing departments. Preference will be given to one with good knowledge of modern gauging methods.

Salary, Rupees 625, plus overseas allowance of £15, rising to Rs. 1350 plus overseas allowance of £30, per calendar month.

First-class free passage.

HEAD PLANNER and ESTIMATOR (Subordinate Grade), age about 30. Preference will be given to a candidate holding a similar position in Railway Workshops or Locomotive Builder's Shops. Applicants must be able to take charge of planning, rate fixing, progress, &c., under the direction of the Production Engineer, and must therefore possess a sound knowledge of laying out detailed manufacturing operations, estimating times and detailing the types of machines on which parts are to be manufactured, and must be prepared to supervise the operations of various classes of modern machine tools used in a large locomotive works.

Salary, Rupees 575, rising to Rs. 650, per calendar month.

Second-class free passage.

JIG and TOOL DRAUGHTSMAN (Subordinate Grade), age about 30 years. Candidates must have specialised in the design of jigs, tools, and fixtures as used in modern production systems, and be able to design complete tool lay-outs for all classes of machine shop work. Preference will be given to one who has served his apprenticeship in an up-to-date locomotive works or engineering shop of repute in addition to his drawing-office experience.

Salary, Rupees 575, rising to Rs. 650, per calendar month.

Second-class free passage.

TERMS.—The terms for all three appointments will include a three years' agreement in the first instance and free return passage home on satisfactory termination of service. Selected candidates will only be appointed subject to satisfactory references and a strict medical examination.

All applicants must state their age, whether married or single, and give full particulars (in chronological order) of their training and subsequent experience, stating the names of railways or contractors by whom they have been employed, and the class of work employed upon, with dates in each case. Details should be given of any previous experience abroad, together with copy of leaving certificate.

Letters of application (marked outside "Progress Staff") must be accompanied by COPIES ONLY of testimonials, and should be addressed to the undersigned not later than 21st May, 1928.

Messrs. RENDEL, PALMER & TRITTON,
12/14, Dartmouth-street, Westminster, London, S.W. 1.
8396

PUBLIC NOTICES

Hartlepool Port and Harbour COMMISSION.

ENGINEER, SECRETARY and HARBOUR MASTER (One Post) REQUIRED IMMEDIATELY. Salary £400-£500 per annum, according to experience. Candidates, under 35 years of age, who must be Associate Members of the Inst. C.E., must have had at least 5 years' practical experience of Dock and Harbour Works.

Applications, enclosing statement of qualifications, age, war service, &c., and copies of three recent testimonials, must be received before May 21st.

J. D. HOWKINS, Secretary,
Hartlepool Port and Harbour Commission,
30, Town Wall, Hartlepool. 8392

The Mond Nickel Company, Limited,

invite APPLICATIONS for the following POSTS :—

METALLURGIST (or Engineer with Metallurgical training), having a thorough knowledge of the theory, treatment and application of Alloy Steels. Research experience essential and metallurgical degree desirable.

TECHNICAL ASSISTANT to Chief of Department in London. Some metallurgical training essential, experience in dealing with technical correspondence and supervision of publication work desirable; should be accustomed to interviewing and office routine.

Applications to be made by letter, accompanied by copies of testimonials and references to any published work, stating qualifications, age and salary required, to the SECRETARY, Research and Development Department, The Mond Nickel Company, Limited, Victoria Station House, London, S.W. 1. Mark envelopes "Metallurgist" or "Technical Assistant."
8374

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

8227. TECHNICAL ADVERTISING ASSISTANT, appeared in April 13th issue. Will the applicants for this post kindly accept this intimation that the POST has been FILLED? 8422 A

WANTED, a First-class DESIGNER, Competent to get out designs and estimates for Uniflow Engines and to carry the work through after the order is secured.

None but first-class men, who have had long experience in this line, need apply.

State age, give full details and experience and salary required, and when at liberty.

Address, 8332, The Engineer Office. 8332 A

WANTED, an ASSISTANT ENGINEER, Age 30 to 35. Previous employment should be such as to enable him to Investigate and Report on the Steam and Electric Power Requirements of Collieries. Applicants should have had experience in negotiating sales.—Address, giving full particulars of age, experience, academic qualifications and salary required, 8408, The Engineer Office. 8408 A

WANTED, an ASSISTANT ENGINEER for Shanghai, China. Applicants should have Cambridge University technical training or sound technical training following education at well-known public school. Practical training not essential, but desirable. Age not exceeding 24 years.—Apply in writing, giving full particulars, to the SECRETARY, Shanghai Waterworks Co., Ltd., Thames House, Queen Street-place, E.C. 4. P4493 A

A REPRESENTATIVE for SCOTLAND and the NORTH OF IRELAND, for Steel-frame Buildings. On commission.—Particulars to ARTEX, Ltd., Slough. 8383 A

ELECTRICAL ENGINEER, with Power Station experience and preference also with drawing-office experience, REQUIRED in Lincolnshire by a Firm of Consulting Engineers.—Address, 8419, The Engineer Office. 8419 A

ENGINEER REQUIRED for East Africa for Erection of Steel Buildings, Heavy Oil Engines and Decorticating Plant with native labour, and subsequently undertake running and maintenance.—Address, stating age and salary required, P4479, The Engineer Office. P4479 A

EXPERIENCED ENGINEERING REPRESENTATIVE REQUIRED in Yorkshire by Engineering firm specialising in Reinforced Concrete. Must have established connection with architects, municipal and county authorities, and be capable of Supervising Reinforced Concrete Work in progress. State age, experience and salary required.—Address, 8388, The Engineer Office. 8388 A

GENERAL MANAGER, Engineering Works in England; experienced in control and direction of financial, commercial and technical staffs and workpeople. Practical knowledge of modern workshop methods in construction of all classes of machinery, including Machine Tools, Steam, Electric, Hydraulic and Textile Machinery.—Box 2581, British Engineers' Association, 32, Victoria-street, London, S.W. 1. 8379 A

HEATING ENGINEER, to Take Charge of Department dealing with Automatic Oil Firing. Sound knowledge of the latter essential.—Address, stating experience, age, and salary required, 8344, The Engineer Office. 8344 A

INDIA.—ASSISTANT REQUIRED for the Metal, Machinery and Engineering Stores Department of large works; must have good experience of above work. Unmarried man, 23 to 28 years; five years' agreement, free passage out and home; salary 500 rupees, rising to 600 rupees, per month.—Write, with details of training and experience, and copies of testimonials, to Z. M. 632, care Deacons' Advertising Agency, Fenchurch-avenue, London. 8401 A

MERCHANT ENGINEERS, London, REQUIRE IMMEDIATELY competent ASSISTANT to DIRECTOR, keen buyer and salesman, who knows what to sell and where to sell, age 30. State experience, references, remuneration required. Opportunity for young man of ability and knowledge.—Address, P4494, The Engineer Office. P4494 A

PRACTICAL MACHINERY SALES ENGINEER WANTED, preferably one familiar with Boring Mill practice as well as commercial experience. Applicants should have wide business connections. Personal acquaintance with leading engineers is essential. All communications, which will be regarded as strictly confidential, should furnish particulars of experience, previous connections, salary expected, &c. —WEBSTER and BENNETT, Ltd., Coventry. 8305 A

For continuation of Small Advertisements see page 4.

CORRECTION.

Messrs. ALFRED HERBERT wish us to announce that in some copies of this issue the following correction should be made in their ARTRITOR ADVERTISEMENT appearing on page 13:—

FOR—

P. J. ROBINSON, Esq., City Electrical Engineer.
BABCOCK & WILCOX, Main Contractors,

READ—

R. A. CHATTOCK, Esq., City Electrical Engineer.
INTERNATIONAL COMBUSTION, LTD., Main Contractors.

A Seven-Day Journal

The Royal Tweed Bridge.

THE Royal Tweed Bridge at Berwick, which is to be officially opened by the Prince of Wales on Wednesday, May 16th, is now completed as regards the structural work. It has been built to the designs of Messrs. Mouchel and Partners, of Westminster, and the work, which was begun in 1925, has been carried out by Holloway Brothers, of London and Newcastle. The new bridge is of interest as being the longest reinforced concrete road bridge in the country, and its largest span of 361ft. 6in. is said to create a record in reinforced concrete construction. The bridge has a total length of 1405ft., and consists of two approach spans and four arch spans. The approach spans have lengths of 144ft. 6in. and 199ft., and the four arch spans, which rest on five concrete piers, have lengths of 167ft., 248ft., 285ft., and 361ft. 6in., the large span being on the Berwick side of the bridge. The total width of the bridge is 46ft., and is made up of a 30ft. carriageway and two 8ft. footpaths. There are four arched ribs to each span, and the ribs are hollow from their springing point for a third of the length of the span, the centre portion being solid. From the arch spans vertical supports are carried up to the decking level. The paving of the roadway consists of 2in. of asphalt laid directly upon the decking. The bridge has masonry parapets and the spans are designed to carry safely a moving load of 1350 tons. It is stated that the cost of the bridge, part of which will be borne by the Ministry of Transport, will, including the purchase of land and property, probably work out at about £160,000.

Wages in the Engineering Industries.

ON Thursday of last week, April 26th, the Engineering Employers' Federation intimated to the engineering trades unions that it was unable to accede to the request for an advance in wages of 8s. per week to time workers and of corresponding additions to piecework rates. In announcing the employers' decision, Sir Allan Smith gave the result of an analysis which had been made of nine lost contracts. They were all electrical contracts, and had a total value of about £500,000 on the basis of the British quoted prices. The Swiss total price was £336,000. For labour and material alone the British figure was £341,000, so that without allowing anything for profit, overhead charges and other costs, the British figure was £5000 more than the complete Swiss price, including delivery in this country. At the meeting a statement was circulated giving the results of the employers' third half-yearly ascertainments of actual earnings in the engineering industry. It was shown that the hourly earnings of time workers varied from 1s. 4·85d. in the case of patternmakers to 11·65d. in the case of labourers, with an average of 1s. 1·6d. including labourers and of 1s. 4·1d. excluding labourers. The hourly earnings of piece rate workers varied from 1s. 9·2d. for boilermakers to 1s. 1·8d. for labourers, with averages of 1s. 6·6d. and 1s. 7·65d. including and excluding labourers respectively. The statement also showed the percentages of the different classes of workers engaged on time rates and on piecework rates. In the October period of 1927, 50·4 per cent. of all classes were on time work and 49·6 per cent. on piecework rates. In July, 1914, the percentages were 69·3 and 30·7 respectively, so that since pre-war days there has been a large movement in the direction from time to piecework rates. All these figures are based on the earnings, &c., of 335,000 workpeople of twenty-one years and over, employed by 1586 firms.

Future Atlantic Liners.

REPORTS now current to the effect that the White Star Line and the Cunard Company each proposes to order a liner of the largest dimensions at an early date are neither confirmed nor denied by the companies in question. The White Star vessel, plans for which have admittedly been prepared, is expected to be appreciably larger than the Majestic, and may therefore exceed 60,000 tons gross. The confidence which the chairman of the White Star Line, Lord Kylsant, is known to repose in oil engine propulsion has encouraged rumours that the new ship will be fitted with internal combustion engines. If that should prove to be the case, the plant will greatly surpass in size and power any heavy oil engine installation built hitherto for marine work, and its manufacture would thus be an engineering event of great importance. Harland and Wolff, Ltd., of Belfast, who have constructed so many liners for the White Star Line, are mentioned as the probable constructors of the super "Majestic." The berthing of such a large vessel, especially at New York, would be attended with considerable difficulty under existing circumstances, and the New York harbour authorities are said to be planning the construction of new piers, upwards of 1000ft. long, to accommodate the ocean leviathans of the future. It is stated unofficially that the Cunard Company has not yet decided on the size or speed of its projected liner. There is, however, good reason to believe that her speed will be superior to that of the "Mauretania," which after twenty-one years of almost continuous service is still the fastest passenger liner afloat. In the near future the "blue riband" of the Atlantic is likely to pass into German hands, for the new North German Lloyd liners, "Bremen" and "Europa," now on the stocks, are designed for 26½ knots. With regard to the proposal of the Trans-Oceanic Company of New York to build six 33-knot liners to cross the Atlantic in four days, that scheme, which has been more than once referred to on this page, has been characterised by the United States Shipping Board in its report to Congress as being open to technical criticism, economically unsound, and financially nebulous. Such an opinion will not surprise British marine engineers or shipbuilders, as the scheme has always been regarded here with a certain element of suspicion.

Record Non-stop Railway Runs.

ON Friday of last week, April 27th, the 10 a.m. "Royal Scot" train from Euston was run without a stop to Glasgow, a distance of 401½ miles. The train was drawn by the engine "Cameronian," which was manned by two drivers and a fireman. It arrived at Glasgow Central Station at 6.7 p.m., seven minutes ahead of scheduled time. The coal consumed on the journey was about 5½ tons, out of the 8½ tons which the tender carried. Ordinarily, this train is divided at Symington into two portions, one of which proceeds to Glasgow, while the other goes to Edinburgh. On Friday the Edinburgh portion was run as a separate train and made a non-stop trip between the two capitals, a distance of 398¼ miles. The Glasgow trip establishes, it is claimed, a world's record non-stop run, but it is, we gather, not to become a regular performance on the part of the London, Midland and Scottish Railway. On Tuesday of this week, May 1st, the London and North-Eastern Railway began its regular non-stop "Flying Scotsman" service between London and Edinburgh, down and up, the engines used, the "Flying Scotsman" and the "Shotover" respectively, being provided with the new type of tender in which a corridor is arranged so that a relief crew may obtain access to the footplate during the journey. The down train, with a tare weight of 368½ tons behind the tender, left King's Cross at 10 a.m. and arrived at Waverley at 6.2 p.m., 13 minutes ahead of scheduled time. The up train, with 323 tons behind the tender, left Waverley at 10 a.m. and arrived at King's Cross at 6.14 p.m., 1 minute ahead of time. The distance covered by these runs is 393 miles. Elsewhere in this issue schedules of the running of these two trains are given.

The North-West Midlands Electricity District

IN 1924 the Electricity Commissioners provisionally determined that a certain area comprising parts of the counties of Chester, Salop and Staffordshire should constitute a separate electricity district, and that existing organisations for the supply of electricity therein should be improved. After consultation with the authorised undertakers in the proposed district, the Commissioners formulated a scheme for bringing this improvement about, and in due course the scheme was published. The Commissioners now give notice that at 10.30 a.m. on May 15th, and, if necessary, on following days, they intend to hold a local inquiry in the Town Hall, Stoke-on-Trent, in order finally to determine the area of the proposed district. Any body or person interested may attend the inquiry, either personally or by counsel, solicitor or agent. Copies of the scheme may be obtained on application from the Secretary to the Electricity Commissioners, Savoy-court, Strand, W.C. 2, and any representations or objections with regard to its provisions and with respect to inclusion in or exclusion from the proposed district, should be submitted in writing to the Secretary not later than Thursday, May 10th.

The Chamber of Shipping.

AT a recent meeting of the Council of the Chamber of Shipping of the United Kingdom, some of the subjects which will be discussed at the forthcoming International Shipping Conference, which is to be held in London in June next, were made known. Various suggestions have been received, we understand, with regard to the amendment and improvement of the existing regulations for the prevention of collisions. In connection with this subject, it is proposed that some attempt should be made to simplify and to co-ordinate the three methods at present in use of giving orders to the helm. In the United States Navy the words "left" and "right" are used to indicate the direction in which the ship's head is to turn, and "port" and "starboard" are sometimes employed in other services in a similar way, but by far the more common mercantile marine usage is the employment of the words "port" and "starboard" to indicate the direction in which the helm is to be moved and not the ship's head, which means that the ship is actually turned in a contrary direction to that indicated by the order given. It is thought that the Conference might consider whether it is not possible to find two new words of command which would be as unmistakably different as "port" and "starboard," and could be accepted by the navigators of all nationalities. The words "left" and "right" are, it is pointed out, not satisfactory, as they possess, odd as it may seem, the fault of phonetic similarity which was associated with the old words larboard and starboard. At the same time a uniform method of giving helm orders might with advantage be introduced. Another matter in which the Chamber of Shipping is interesting itself is the future use of coal by ships. A proposal to join the Mining Association in setting up a joint committee of shipowners and coalowners to consider the use of coal at sea was recently approved, and it was left to the President of the Chamber to take further steps in this direction.

Oil Engines for Peak Loads.

THE meeting of the Diesel Engine Users Association, which was held on Tuesday evening, May 1st, and which is referred to elsewhere in this issue, was undoubtedly one of the most successful of the present season, both with regard to the attendance of members and visitors and the discussion which followed the reading of Mr. Maximilian Gercke's paper. In his concluding remarks Mr. Gercke made additional reference to three psychological factors which he said were of importance in considering the problem of using oil engines for peak loads. First, the objection to reciprocating prime movers; secondly, the prejudice of many super-power station engineers against the present comparatively small maximum capacity of oil engine generator sets; and thirdly, the opposition on economic grounds of the importation of foreign fuel oils to supply peak load oil engine installations. Mr. Gercke said that all these objections were founded on misapprehension, and were not justified by facts. He claimed that oil and gas engines of modern design—especially high-powered oil engines—had special merits which, when used in conjunction with steam or water-operated power stations, would undoubtedly have an important influence on the trustworthiness and economy of electricity supply. As regards the importation of liquid fuel, he suggested that the possibilities of producing the required quantities of Diesel oil by low-temperature carbonisation and by the liquefaction of coal ought to be investigated and utilised on a large scale.

New Refuse Power Works at Glasgow.

ON Friday of last week, April 27th, Prince Henry, during his visit to Glasgow, set in motion the machinery of the new refuse power-house which has been constructed at Govan for the service of the Cleansing Department of the Glasgow Corporation. Work on this combined destructor and power works, which are claimed to be the largest of the kind in the world, was begun in September, 1924, by Heenan and Froude, Ltd., of Worcester, who are responsible for the design of the plant. The new works occupy a site of 15¼ acres, and are at present designed to deal with 640 tons of refuse per day. Steam is raised in boilers of the Babcock and Wilcox and Vickers-Spearing type, and there are two 5000 kW Fraser and Chalmers G.E.C. turbo generators, which have a guaranteed output of 50,000,000 units of electricity per annum. The completion of the work has been somewhat delayed by the coal strike difficulties of 1926, and by the necessity of adding new buildings and plant to meet the requirements of the Electricity Commissioners and the Electricity Department of the Glasgow Corporation. The destructor plant is so designed that the refuse is handled with the minimum of manual labour. The total cost of the new works with the extensions, to which we have referred, is given as £600,000.

A New Thames Pier.

IT is announced by the Port of London Authority that work will shortly be begun on a new pier at Tower Steps, close to the western extremity of the Tower of London. The object of the new pier, which will be probably named the Tower Pier, and will be ready for service next season, is to provide easier navigating facilities for the pleasure steamer traffic which at present uses the Old Swan Pier. As the pleasure steamers have in recent years increased in size, it has been found more difficult to navigate them easily in quick-running tides and in a river often filled with traffic. The new pier will be midway between London Bridge and the Tower Bridge, and the steamers will be able to steer directly for it, without having to navigate the narrow and swift currents of a bridge arch. In addition, good access to the new site is given from Tower-hill. Many will regret the passing of the Old Swan Pier, which is to be demolished when the new structure has been put into service. Records of that pier go back to the years before 1857, when it was taken over by the Thames Conservancy. That Authority rebuilt it in 1862, and after it had been in the care of the London County Council for a few years, it passed, in 1909, into the charge of the Port of London Authority. It took its name from the *Old Swan Inn*, which is mentioned in Pepys' Diary.

An American Experimental Arch Dam.

(Contributed.)

INCREASING numbers of engineering projects in the United States involve the construction of dams for water supply, irrigation, hydro-electric power and flood control. For many of these purposes the simple arch type of concrete dam, depending upon its arch action for stability and strength, has particular advantages, but the economic design of dams of that type is hampered by lack of knowledge of stress conditions. In the absence of information derived from experimental investigation, the design must be based upon purely theoretical assumptions and calculations. As a natural result, there is entire lack of agreement or congruity in different designs. Among dams comparable in length and height, some are thin and others thick, owing to variations in the assumptions made and in the factors of safety allowed by bold or conservative designers.

It is true that, apparently, there is no record of failure of a simple arch dam—that is, failure as an arch—but this favourable showing is discounted to some extent by conflicting claims that some of these dams are so thin as to be near the danger line, while others are of excessive thickness and strength, with unnecessarily high cost. In other words, the supposedly heavy dams may not be economic structures, and designs based upon greater scientific knowledge might be much less costly, without any reduction in safety. With such scientific knowledge, the arch type of dam might be suitable for many projects and conditions, for which, at present, its use appears to be of doubtful value as compared with dams of other types.

An outcome of the increasing need and demand for definite knowledge of the stress conditions in arch dams is the bold undertaking to construct a fairly large dam for test and experimental purposes only, the test being continued, perhaps, to actual destruction under load. This novel and important development in engineering research has been arranged under the direction of the American Engineering Foundation, while the tests and studies are being made by a committee of the American Society of Civil Engineers, with a staff of resident engineers and assistants. Funds for this enterprise are provided by subscriptions from engineers, power companies, technical and commercial organisations and others interested for scientific or practical reasons.

The site selected for the experimental dam is on the Stevenson Creek, a tributary of the San Joaquin River, in California. There, there is a U-shaped gorge in solid granite, which has a steep slope of about 1 in 4. At the site of the dam the gorge is so narrow and steep that the reservoir formed is of only small capacity. This reservoir can be emptied rapidly, the impounded water being discharged into the creek and the river by means of a tunnel, 4ft. by 7ft., in section through the solid rock under the dam and having a vertical shaft to the bed of the creek on the upstream side of the dam. This shaft is normally closed by a roof of heavy timbers or stop logs, the discharge being through a 24in. pipe leading into the tunnel and fitted with a valve. If the dam should be tested to destruction, with the reservoir full, the volume of water suddenly discharged would cause no inconvenience to persons or damage to property.

Water for filling the reservoir as desired has been made available by means of a tunnel branching from the main pressure tunnel of a hydro-electric plant in the neighbourhood. When the flow of water in the creek is not desired for the reservoir, it is diverted to a 24in. wood stave iron-banded pipe, which is led over the top of the dam and discharges on the downstream side.

The Stevenson Dam, as shown in Fig. 1, is 60ft. high. It is built of plain or non-reinforced concrete.

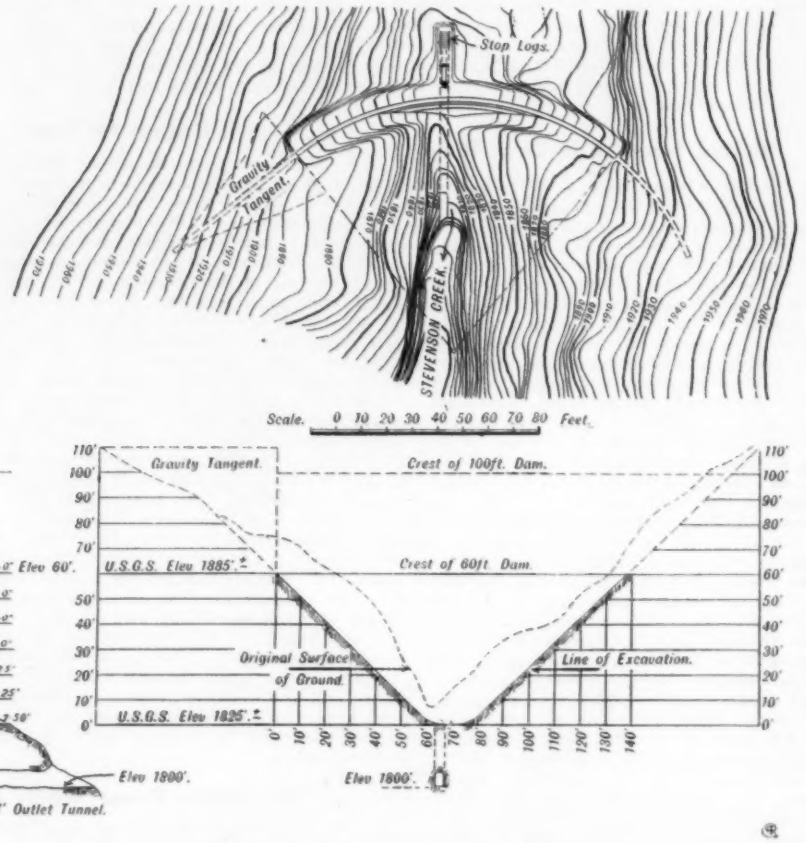


FIG. 1—THE STEVENSON EXPERIMENTAL DAM

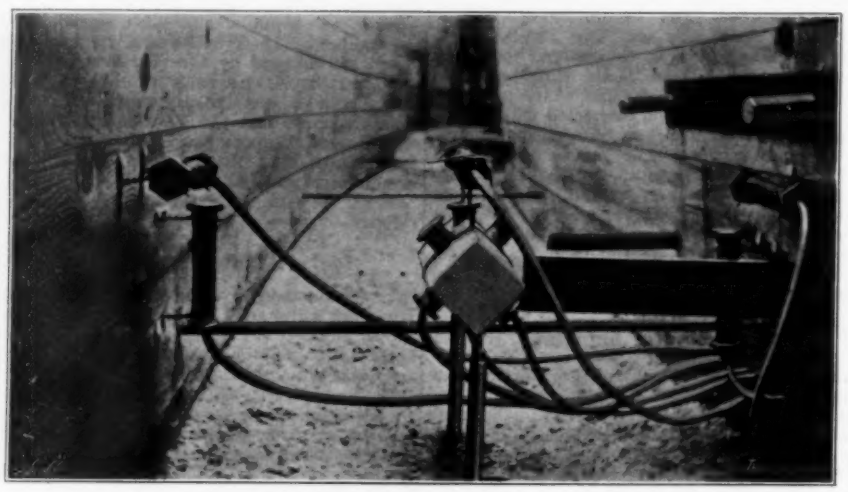


FIG. 2—MEASURING INSTRUMENTS READY TO BE EMBEDDED IN CONCRETE

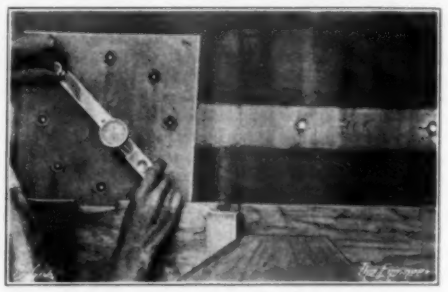


FIG. 3—FIXED POINTS FOR MEASUREMENTS

Its upstream face is vertical, with a constant radius of 100ft., and length of about 150ft. on top, where the central angle is about 80 deg. The thickness at base is 7½ft., and it tapers to 2½ft. at a height of 30ft., and retains that thickness to the top. If the height is increased to 100ft., as is proposed, an abutment will be necessary at one end, owing to the flattened slope of that side of the gorge. This abutment will be of gravity section and tangent to the arch. It will serve also for tests on the transmission of arch reactions to the abutment. After the programme of tests on the 60ft. dam has been completed, the height of the dam will be increased in 10ft. stages, a series of tests being made at each successive stage. These tests will be carried on until the dam fails or until it reaches the 100ft. height, which is the economic limit for the situation.

In the design, combined cantilever and arch action were assumed, but with high tensile stresses. If these stresses in the cantilever had been limited to ordinary values, the base thickness of the dam would have been 9½ft. or 10ft. The modulus of elasticity of the concrete was assumed at 2,500,000 lb. per square inch for the arch and 2,000,000 lb. for the vertical cantilever, the latter taking into account the smaller stresses and the addition of shear deflection. Under the subdivision of load to which these stresses correspond, the deflection lines of arch and cantilever are practically coincident. It was intended that the measurements of deflection and stress should cover all variable factors, such as temperature changes, depth of water and shrinkage of concrete. Also, the proportions of water pressure supported by horizontal arching and by vertical cantilever and beam action. It was considered that the maximum tensile stresses in the cantilever would be high enough to cause a crack near the base when the water was nearly

FIG. 4—THE DAM UNDER CONSTRUCTION

at the 60ft. crest; but it was intended to keep the water at a lower level during the earlier experiments, unless the extensometer measurements should show the actual tensile stresses were materially smaller than those arrived at by theoretical calculations.

The committee in charge pointed out at the beginning that the possibility of inclined arch action, the relative stiffness of the shorter vertical cantilevers higher up in the dam, and other complications, made an accurate determination of the stresses in an arch dam a difficult problem. It was hoped that the experiments on this test dam would furnish reliable data for making simplified assumptions upon which to base the design of future arch dams. It is of particular interest to note that in tests of a celluloid model, one-fortieth of the size of the dam, the results confirmed the measurements on the actual dam to a remarkable extent. A larger model, one-twelfth of full size, is being built of concrete. On both these models the loading is applied by quicksilver in india-rubber bags.

FIG. 5—THE COMPLETED DAM

The construction of the Stevenson dam was begun in April, 1926, and completed in June of that year, the concrete being carried up in 5ft. stages. During the building of the structure, various testing devices and metal reference marks were set in place and embedded in the concrete. The dam was also equipped with instruments of high provision for measuring strains, deflections and temperatures. Fig. 2 shows some of these instruments in place, ready to be embedded in the next 5ft. layer of concrete, and Fig. 3 shows some of the fixed points for measurement, with a strain gauge applied. The dam under construction is shown in Fig. 4, and the completed dam in Fig. 5. Trestle work was erected to enable observers to have access to all points. Electric lights were provided on both sides of the dam.

During the entire process of construction the concrete was kept wet by means of small streams of water from hose or perforated pipes, the water trickling down the faces of the dam, except when test measurements were being made and also during a period of seven days, when the concrete was allowed to dry for some special observations. This continuous wetting was done to prevent undesirable shrinkage during the curing of the concrete. Examination showed the dam to be a highly satisfactory structure, accurate in shape and dimensions, and free from any objectionable defects. The selection of cement and aggregates, and the mixing and placing of the concrete were controlled carefully with a view to getting concrete of an ordinary character, but as uniform as possible in strength and density. For this purpose, an inundator was used to control the proportion of water and sand, taking into account the moisture of the sand as delivered at the concrete mixer. As a result of this care in construction the concrete has shown a high degree of uniformity in strength, averaging a little more than 2000 lb. per square inch after twenty-eight days, as compared with an intended strength of about 1800 lb. per square inch.

Leakage was very slight while the tests were in progress. For the construction work, through bolts were used to tie together the forms on the two sides of the dam, and when the water was 40ft. to 60ft. deep, there were moist spots at about one-fourth of these bolts, the water seeping along them, although the bolts did not extend to the surface of the concrete and the pockets had been packed with cement mortar. Leakage around the ends of the dam was mainly through rock fissures at some considerable distance from the dam. No leakage through the concrete or at any of the construction joints appeared, until at 50ft. head a small moist patch, only about 4in. by 7in. appeared at a construction joint 15ft. above the base of the dam. At 60ft. head a larger damp spot about 4ft. by 7ft. appeared at the joint at the 20ft. elevation, and a few small patches—not more than 12in. in diameter—at the construction joint at the 55ft. elevation. The leakage under 50ft. head was estimated at 6 gallons per minute, most of which came through rock fissures and only about 5 per cent. through the dam. Although the total was greater under 60ft. head, the proportion coming through the dam was found to be less than under a head of 50ft.

Water was first let into the reservoir for experimental work on July 12th, 1926. Tests were begun with water 20ft. deep against the dam, and the depth was increased 10ft. at a time until the water was brought level with the top of the 60ft. dam in September. For each stage a series of measurements was made with the reservoir full and empty. This work was done at night, so that temperature changes would be at a minimum during the period of several hours required for making and recording the many hundreds of measurements. During the construction of the dam and the curing or setting of the concrete, observations were made as to strains and deflections due to variations in temperature and moisture. These tests showed that the structure responded in a marked degree to the variations in atmospheric conditions. According to official statements and records, the strains derived from the measured deflections were found to agree with the strains measured directly by the strain gauges and electric telemeters, while the deflections computed from strain measurements agreed fairly well with the deflections as measured directly. Furthermore, there was reasonably close agreement between the strains measured with the gauges and with the telemeters. Bending strains were distinguished clearly from strains due to direct compression. In Fig. 6 is shown an isometric drawing of the vertical or upstream face of the dam as deflected with a 60ft. head of water.

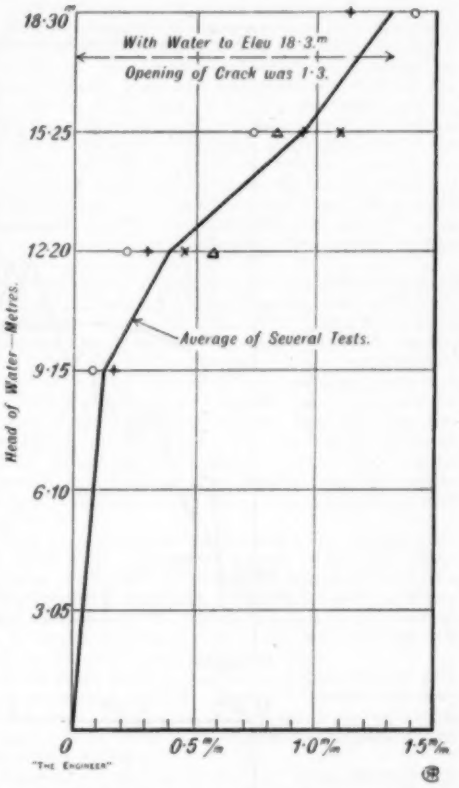


FIG. 9—OPENING OF CRACK WITH DIFFERENT HEADS

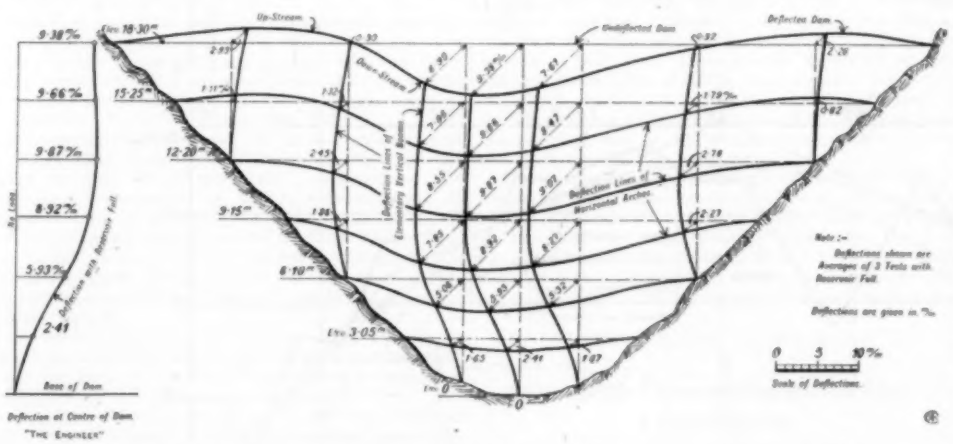


FIG. 6—DEFLECTIONS IN UPSTREAM FACE OF DAM UNDER 60FT. HEAD OF WATER

Measurements showed that the foundation rock moved about 0·001in. in the downstream direction. With the force of the arch thrust also, the rock walls of the gorge showed a spreading or lateral movement of about 0·03in. at the 17ft. and 33ft. levels. The amount of spread for varying heights of water is shown in Fig. 7. These measurements were taken along the long chords at the two elevations. A ¼in.

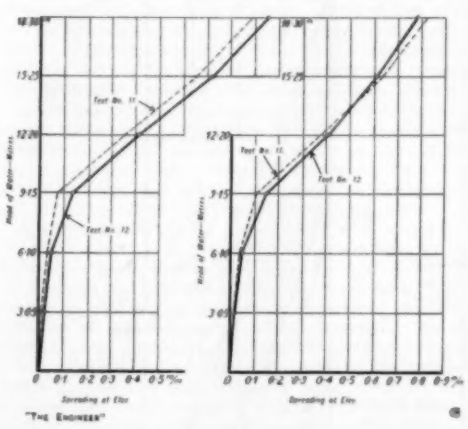


FIG. 7—SPREAD OF WALLS WITH DIFFERENT HEADS

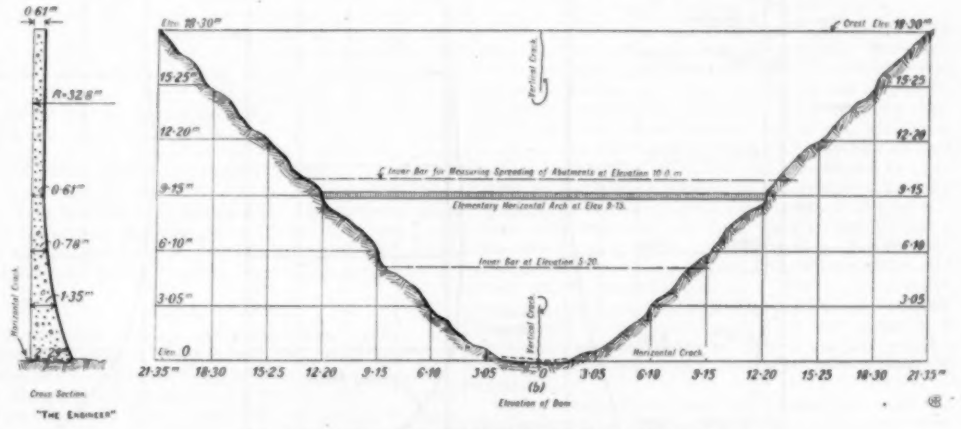
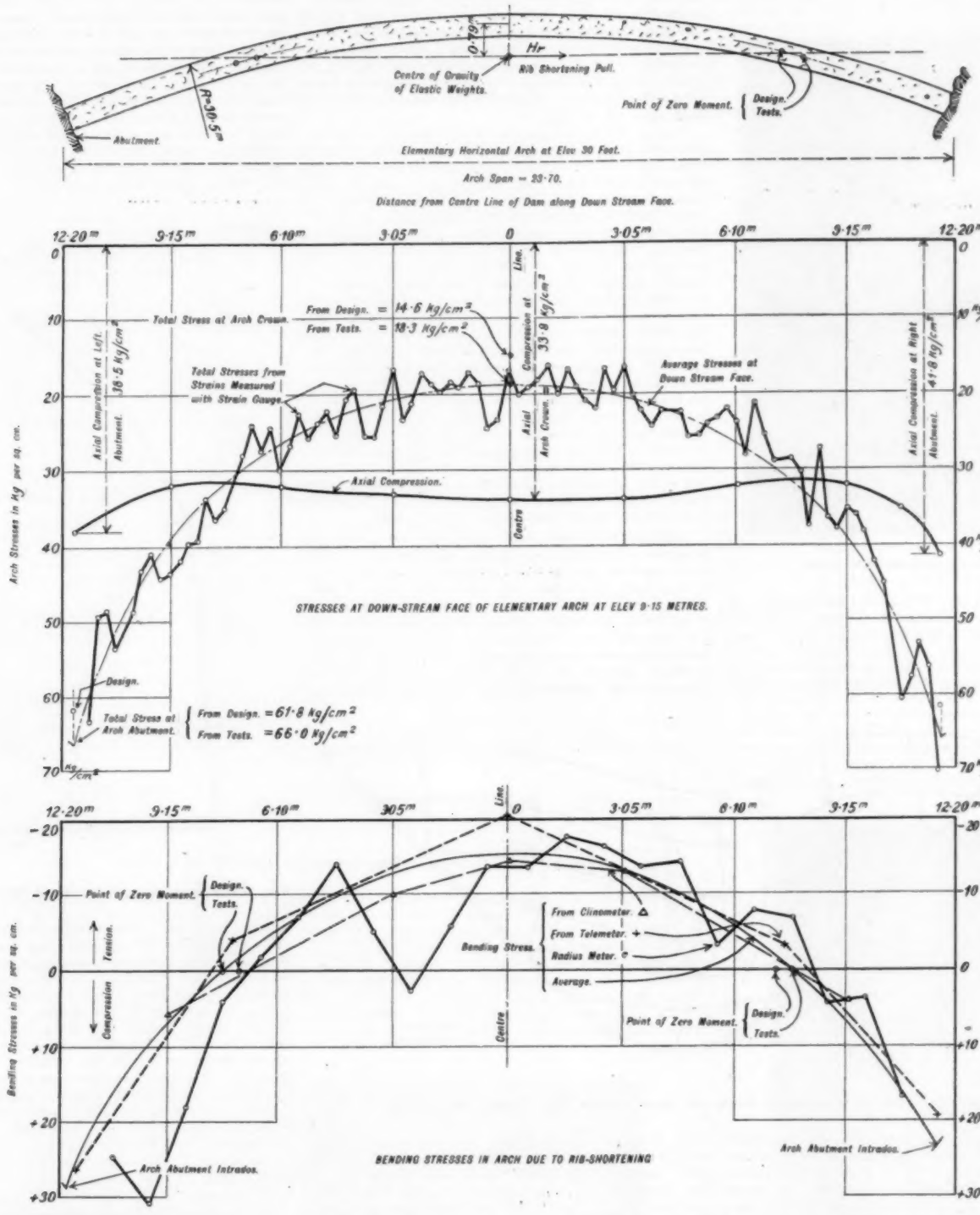


FIG. 8—DIAGRAM SHOWING POSITIONS OF CRACKS

THE STEVENSON EXPERIMENTAL DAM—RESULTS OF TESTS


Hr
Rib Shortening Pull.
Centre of Gravity of Elastic Weights.
R=30·5m
Abutment.
Point of Zero Moment. Design. Tests.
Elementary Horizontal Arch at Elev 30 Feet.
Arch Span = 33·70.
Distance from Centre Line of Dam along Down Stream Face.
12·20m 9·15m 6·10m 3·05m 0 3·05m 6·10m 9·15m 12·20m
Arch Stresses in Kg per sq. cm.
Total Stress at Arch Crown.
From Design. = 14·6 kg/cm²
From Tests. = 18·3 Kg/cm²
Total Stresses from Strains Measured with Strain Gauge.
Axial Compression at Left. Abutment. 18·5 Kg/cm²
Axial Compression at Crown. 33·8 Kg/cm²
Axial Compression at Right Abutment. 41·8 Kg/cm²
Average Stresses at Down Stream Face.
Axial Compression.
Centre Line.
STRESSES AT DOWN-STREAM FACE OF ELEMENTARY ARCH AT ELEV 9·15 METRES.
Design.
Total Stress at Arch Abutment.
From Design. = 61·8 kg/cm²
From Tests. = 66·0 Kg/cm²
Bending Stresses in Kg per sq. cm.
Point of Zero Moment. Design. Tests.
Tension.
Compression
Bending Stress. From Clinometer. From Telemeter. Radius Meter. Average.
Arch Abutment Intrados.
BENDING STRESSES IN ARCH DUE TO RIB-SHORTENING
Reservoir Full.
0·61m Elev 18·30m
R 30·5m
15·25
12·20
9·15
6·10
3·05
Elev 0
Deflection (Observed).
0 5 10 m/m
"THE ENGINEER"
Bending Moment.
(+)
0 50 100 150 200 m+n
for 1 m. width.
Curve of Division of Load.
Shear.
20 40 60 +n
for 1 m. width.
Total Load from Test Data.
Design.
Tests.
Total Water Pressure.
Load Carried by Horizontal Arches.
Load carried by Vertical Beam.
A B C D E F
0 5 10 15 20 t/m²

bar of invar steel was attached to a heavy steel plug set in the bed rock at the north end of the dam at each of these elevations, the bar extending along the direction of the long chord to a corresponding point at the south end, where the bar was in contact with the plunger of an Ames gauge, attached to another steel plug embedded in the rock.

Under a head of 30ft. of water a horizontal crack appeared at about the middle of the gorge, between the bottom of the dam and the foundation rock, on the upstream side. This is shown in Fig. 8. By means of an electrical resistance instrument or resistance micrometer, operating under water, a maximum opening of 0·05in. was recorded. The opening of this crack under higher heads of water is shown in Fig. 9.

The first crack within the body of the dam occurred with the water 50ft. deep. This was a vertical crack on the centre line, extending entirely through the dam, from face to face, and to a depth of 11ft. on the downstream face, though not so far on the upstream face. Its position is shown in Fig. 8. Later, it extended to about 19ft. below the crest. Further tests showed the variations in width of this crack with variations in head of water against the dam. It is evident that this crack began opening under a very small head—5ft. to 10ft.—and continued to open until the maximum width was 0·016in. on the upstream side at 45ft. head and 0·035in. on the downstream side at 50ft. head. With higher heads the crack closed gradually until the water reached the crest elevation at 60ft. With the head increased to 60ft. another vertical crack developed at about the centre line, beginning at 2in. above the rock foundation and extending upwards about 9ft., which distance increased ultimately to 13ft. This also is shown in Fig. 8. In each of these cases the crack was discovered by means of telemeter readings. For the second crack, the measured stress just before its formation was about 570 lb. per square inch, which agreed reasonably with the tensile strength of the concrete as used in this dam. Just before the first crack opened, the measured stress was about 300 lb., but it is considered probable that the total stress was made materially greater by vibratory stresses set up as a result of partially opening the 24in. discharge valve already mentioned. These stresses were based upon a modulus of elasticity of 4,000,000 lb. per square inch for the concrete of the dam.

A comparison of the results obtained in the measurement of strains in the dam by different methods is shown in the upper drawing on page 480, the three lower curves of which show the bending strain at the surface of the concrete along the horizontal element at the 30ft. elevation. These three curves are based upon strains determined by three independent methods—first, from the difference of strain on the upstream and downstream faces, as given by the telemeters; secondly, by double differentiation of the deflections at this elevation, as found by use of the clinometer; thirdly, from readings taken with the radius meter, which measured a change in the middle ordinate of a 40in. arc of the dam. This change in length of ordinate is proportional to the bending strain.

The upper curve in this drawing, which represents total strain derived from strain gauge measurements, gives the sum of the bending and direct strains as measured on the downstram face of the dam. An average curve through the data of total strain obtained from the strain gauge is quite symmetrical about the centre line. There are, however, individual variations from point to point which make a very irregular diagram. It is not certain how much of this irregularity is due to errors in observation and how much to lack of homogeneity of the concrete along the arch ring, but it is believed that an appreciable proportion is due to the latter cause, since the irregularities occur frequently in groups of three or more points. The close agreement of the three upper curves is taken as a good indication that reliance can be placed upon the results obtained. Since the lower curves represent bending strain only, and the upper curve represents the sum of the bending strains and direct strains, the difference between the two average curves—represented by the vertical distance between them on the diagram—is the strain due to the direct axial compression in the arch ring. In the opinion of the observers, this direct compression is shown to be nearly uniform throughout the length of the arch at the elevation where the observations were made.

A statement made by the committee in charge of the tests shows that from the observed data as to deflections and strains, the moments and shears in the vertical and horizontal elements have been determined, as well as the manner of division of the total pressure of water between these elements. As an example, the curves at the bottom of page 480 are given. They show, first, the deflections on the vertical centre line of the dam under a head of 60ft. The bending moments, shears and loads on this vertical element, 1 m. in width, as deduced from the deflections above the 15ft. elevation, are also shown, as, too, is the total pressure due to water at the several heights. The moments, shears and loads carried by horizontal elements have been determined in the same way. Since the sum of the loads carried by a vertical element and a horizontal element within the area of their intersection must be equal to the total water pressure applied upon that area, a test of the accuracy of the observed results is afforded by a comparison of the combined loads with the total water pressure at a given point. Although such comparison does not show perfect agreement, the curves indicate that the results are close enough to give confidence that a good general idea is being obtained of the way in which the loads are carried to the foundation and the abutments.

The plotted points for the deflections, shown by the curves at the foot of page 480, were obtained from direct measurements. The plotted points for moment were obtained by differentiation of the observed deflections. The curves for deflection and moment are the results of successive integrations of the load curve, and the agreement between the plotted points and curves indicates that the loads shown correspond closely to the deflections observed. The shear curve gives the total shear carried on the section. The average shearing unit stress for any level or elevation is obtained by taking the total shear indicated and dividing this by the sectional area of the element. In the three curves at the right at the foot of page 480 the plotted points indicate the loads carried by the central vertical element 1 m. wide, and transmitted as shear to the bottom of that element. To the loads carried by the vertical elements are added those carried by various horizontal elements 1 m. wide, within the area of their intersection with the central vertical element of the dam. The sums of these loads on the vertical and horizontal elements should be equal to the total water pressure per square foot at all elevations. It will be noted how the loads agree with the total water pressure, which is shown by a straight line.

In addition to the carefully planned tests, the dam has been subjected to severe conditions of loading by unexpected floods. After the completion of the programme of tests in 1926, the stop logs closing the sluiceway or tunnel under the dam were removed, and it was assumed that all the water coming down the creek would be carried away through the tunnel. But in November a severe storm caused a flood which brought down so much rock, sand and *débris* that the sluiceway tunnel was blocked. The reservoir then filled and water flowed over the top of the dam throughout the winter, its depth reaching 3ft. on the crest. However, an inspection in January, 1927, indicated that the cracks at the top had not extended appreciably, although the crack at the bottom had widened, and had extended down to the foundation, but that the dam had not been affected to any extent by this severe test. Later it was subjected to still another flood test, with the same result. However, the floods, with their *débris* and their destruction of the observation platforms and scaffolding, prevented the carrying out of the programme of tests at low temperatures during the winter.

The dam has not yet been built up to the additional height of 40ft., so as to make its total height 100ft. owing, it is believed, to the necessary funds not being, at the moment, forthcoming. Moreover, the full details of the results obtained on the 60ft. dam have not yet been made public, owing, doubtless, to the time required for mathematical work and study.

General Development of the Locomotive.

(By a Continental Engineer).

No. IV.*

THE arguments in support of the increased efficiency to be derived from very high pressures, for stationary and marine engines apply theoretically to locomotives, taking into account the fact that they are non-condensing engines, but there is a difference in practice. In fact, a pressure of about 250 lb. per square inch seems to be the maximum practicable with the normal locomotive boiler by reason of its general design, of the inside fire-box—especially when of copper—and the number of stays that it needs. Boilers with internal parts, under external pressure, are not suitable for very high pressures. To go beyond the figures quoted above would very probably mean adopting another type of boiler, water-tube certainly, and it is well known that no attempts in this direction have so far been successful on the locomotive engine, the standard boiler being so well adapted to the work, to the general arrangement of the engine and to the limitations imposed on it by the loading gauge.

FEED HEATING.

Feed-water heating has gained some favour, and several railways in Great Britain and on the Continent are either trying or applying on a moderate scale, more or less complicated devices for that purpose. Instead of making use, as in stationary boilers, of the heat contained in the lost gases, the systems now used employ part of the exhaust steam, the amount of this steam being considered in most cases greater than necessary to secure a sufficient draught. The heating surface of such apparatus is less than when heat is taken from the gases, but there is another advantage, the temperature of the gases varies in a great measure according to the draught and the power developed, whilst the temperature of the exhaust steam is sensibly the same; of course, the weight of this steam, exhausted per minute, varies with the power, but the quantity of feed-water also varies in about the same proportion. Thus the system is to a certain degree automatic.

Feed-water heating is far from being a new thing. As early as 1850, many continental, and probably British engines, were fitted with a special pipe and cock at the hand of the driver, which enabled steam from the boiler to be injected into the tender tanks through the ordinary feed pipes, when standing or when the safety valves lifted, so that no steam was lost. The invention, by Giffard, of the injector which needed cool water in order to work, stopped for a while this practice; but, in fact, this apparatus was also a live steam feed heater, though it did not raise the temperature of the water by many degrees.

However, every railway engineer knows that in Great Britain, partly before and partly after the introduction of the injector, feed-water heating by exhaust steam was used on some scale, first by Mr. Beattie on the L. and S.W., Mr. Stroudley on the L.B. and S.C., and later on again by Mr. Drummond on the L. and S.W. after many years of disuse, if not of disfavour. The water being frequently very hot, the feeding of the boiler was effected by means of donkey pumps. It is to be noted how feed-water heating on locomotives has been successively, often on the same railway, adopted, then given up and later on returned to.

In the systems mentioned, the feed water is heated in the tender tanks. Applications of a rather different system are now to be seen. They allow a complete independence between the engine and the tender. This is not without importance on some continental or American lines where the locomotives have not always their own tenders bearing the same numbers. Several French railways and two English companies are trying an apparatus, also heated by exhaust steam, placed on the running board of the engine. Experience will show whether the practical results to be obtained are worth the extra complication and weight.

Feed heating for locomotives has, to a certain degree, an advantage probably greater than the slight increase of efficiency to be derived from it, namely, the precipitation in the tanks of a notable portion of the lime salts contained in the feed water, if it is heated to a sufficient degree. It ought consequently to reduce the scale in the boiler.

Feed-water heating can to a certain extent and with advantage, take the place of a variable exhaust; the excess of steam when the draught is stronger than required being used in the apparatus or passed into the tender tanks.

American practice shows the most noteworthy examples of the development that the locomotive is susceptible to take, when circumstances renders it useful and if the local conditions, such as permissible weights, large structure gauge, strength of couplings, allow it. These locomotives are a remarkable achievement, showing great boldness and skill on the part of their designers, but they answer to conditions that are not to be found in Europe, and they must not prevent us from appreciating the different and essentially British ideal and traditions which have prevailed for many years, several times pointed out in the course of these articles, and which have given results adapted to the needs of the country.

As we have said above, it is at a time when electrification, particularly successful in countries endowed with water power, attracts attention, that the steam locomotive has attained the greatest development, that its evolution has never been so rapid, and that it has far outpassed the limitations formerly considered as imperative. It has never been so perfect as to-day, and it receives continual improvement.

BRITISH AND FOREIGN LOCOMOTIVES.

The closer connection between various countries and the development of technical literature have certainly contributed to a greater uniformity in types of locomotives than was observable formerly. However, notable differences in the general design, and probably greater differences in the details of construction, exist still and will probably last as long as the locomotive, owing to the prevalence of local ideas, to the kind of service, to the grade of fuel, the equipment of permanent way, &c. Of course, these differences do not bear on the disposition of the wheels and 4–4–0, 4–6–0, 4–6–1, 2–8–0, &c., engines are now to be found in all countries and even on all gauges, but they affect proportions, maximum powers, mode of construction, and general appearance—which, secondary as it may seem, is a certificate of nationality in one word, the general practice concerning the elements susceptible of variation.

Some comparisons may be interesting, and we shall as much as possible select the most typical cases and endeavour to give a *résumé* of what must be considered as defining the practice of different countries.

The profile of the lines has evidently played a great part in the early determination of the type of the engines of respective countries. Thus, Austria, Central and Southern France, and Italy, having very long and heavy gradients in the mountainous districts,

* No. III. appeared April 27th.

were the first to introduce the eight-coupled locomotive. I believe that the old Mediterranean Railway of Italy was the first in Europe to build 4–6–0 passenger engines—1883—allocated for use between Genoa and Alessandria, where the gradients are, in places, as much as 16 per 1000. The same evolution has taken place in the United States, but on a much larger scale. To-day, the ever-increasing weight of trains has had the same effect on lines with easy gradients, and types of engines, which would have been previously specialised for long gradients, have become main line locomotives.

It must not be forgotten, too, that the tractive effort of locomotives is limited by the strength of the couplings and of the wagon frames. The American type of coupling has permitted the use of engines having a tractive force widely surpassing what would be possible in Europe, though most of the railways have, for some years, reinforced their couplings.

British Locomotives.

Fifteen years ago at the utmost, it would have been a matter of small difficulty to summarise British ideas and practice concerning the design of locomotives. Most of the traditions are still observed, but new circumstances have arisen, new needs have occurred, and the classic standard engine, though forming still the bulk of the motive power, has given place, on some lines, to new locomotives, which, although they still bear the national mark, are not so distinctly British, and in which some continental or American influence is observable to a greater or less degree. We shall have, therefore, to make some distinction between normal British engines and the new and powerful locomotives to which we have just alluded.

British locomotives are designed in accordance with the following conditions :—

Excellent, strong and even permanent way.
Good grade fuel.
Limited structure gauge.
Special conditions of traffic, four-track main lines, great density of the railway systems.
Long-established traditions.
Predominance of practical over theoretical considerations.

We need not return to these items, dealt with in these columns in 1926—see "Notes on British Railways," by "A Continental Engineer"—in detail. We may for the present accept them as acknowledged facts which have had a strong repercussion on the general design as well as on the constructive details of engines.

But when dealing with British railways it must always be born in mind that the permanent way, on the systems as a whole, is by far the best in the world as regards strength, smoothness, drainage and maintenance. This excellence is not a recently acquired quality, for it struck the stranger who was able to appreciate it in the early 'eighties and perhaps before. It was well characterised by a foreign writer who spoke of "the velvet of British railways." Of all the points distinguishing the British railways, it is certainly the most striking and undeniable.

British locomotive engineers have a special ideal and seem to separate with regret from classic forms and proportions and do so only in presence of well-asserted needs and in the expectation of positive results. They have, generally, proceeded step by step in the proportion demanded by the conditions to be met.

British railways have always held as a principle that one should exact the maximum power with the minimum weight consistent with the work the engine is called to upon perform, and the least possible modifications of existing types. They have advanced progressively, not venturing, without necessity, out of the usual track, but being open, of course, to necessary improvements. This school has produced remarkable engines in its time, engines which did exceptional work for their size. The old Midland Railway, with Mr. S. Johnson as its locomotive superintendent, can be taken, I believe, as a typical representative of this state of mind. But, of course, similar results could not have been obtained if good Derbyshire coal had not been at hand. The new express engines of the L.M.S. Railway offer little change and continue the tradition. They are real models of the moderate size and well-proportioned engine; symmetrical, neat and compact, the last word of the British 4–4–0 locomotive. We should say the same of the eight-wheel express engines of the L.N.W. and S. Railways. Other examples, chosen from many others, of pre-war locomotives having the same characteristics, are furnished by the "Atlantic" types of the old Great Central or North-Eastern railways.

The present generation of locomotive engineers, though not forgetting the traditions, is not as restrained by them, and is more eclectic. Furthermore, on some lines, the conditions have changed, the trains are heavier, the services more difficult, and the necessity to work the railways more economically is felt.

The "Atlantic" and the ten-wheel engine have made successively their appearance, and, more recently, the "Pacific" and "Mikado" types, the "Mogul," and eight-coupled engines—0–8–0 or 2–8–0—for mixed or goods traffic. It must be remembered, however, that the L and N.W. built eight-coupled locomotives as far back as 1891.

The old Great Northern was the first to introduce the wide fire-box.

For a very long while, the use of inside cylinders prevailed for four or six coupled, even eight-coupled, tender or tank engines. The arrangement adopted for the motion was excellent as regards compactness and accessibility from the outside. It was a model arrangement; neat and straightforward. It is still in favour for many types of recent build, especially 0–6–0 engines for mixed or goods traffic.

The extensive use of crank axles, at least for engines of moderate size, is not open to criticism. These axles need simply careful watching and serious inspection when the wheels are removed for repairs. They are withdrawn when showing cracks of definite importance. Many of them have performed considerable mileages. But, being given the small distance between the frames, the use of inside cylinders—when two cylinders only are used—is limited to engines of a certain power, owing, in the first place, to the impossibility of finding room for them, and in the second place of allowing sufficiently long bearings and the necessary thickness of the webs. When the two cylinders are cast in one piece, in order to bring them closer together, both have to be scrapped if one of them, or their steam chests, happen to be seriously damaged. This inconvenience is particularly felt with four-cylinder compounds, having their low-pressure cylinders between the frames.

A very extensive use of built-up crank axles which originated in England, is made by several companies, of which, if I am not mistaken, the first were the L. and N.W. and the L. and S.W. It is a good device, long used on marine engines, when the workmanship leaves nothing to be desired and if the shrinkage is well calculated. Of course, the cranks must be assembled hot, and not by pressure. The crank axles of locomotives are subjected to much more severe conditions than marine crank axles and are liable to several kinds of stress which are not met with at sea, as, for example, the vertical shocks on the rails and the horizontal and transverse reactions on the flange of the wheels caused by side motion, or when going through curves of small radius. Most of the cracks of crank axles are occasioned by horizontal impact or pressure against the rail, and the resulting effect is greater as the diameter of the driving wheels is larger. It is a well-known fact that, all things being equal, the life of crank axles is longer when the wheels are of small diameter as they are on goods engines. When an inside cylinder engine is forced through curves of too short radius for the wheel base, cracks are caused in the crank axles, which may cause failure, sometimes months afterwards, if not carefully inspected in the interval. Some locomotive engineers, such as Mr. Worsdell, at one time devised such axles having longitudinal flexibility, but this practice does not seem to have been continued.

To avoid such injury and to allow the engine to negotiate sharp curves, it is or it has been a common practice in Great Britain and in the United States to use blind tires for one of the middle driving or coupled wheels. This practice is very seldom followed on the Continent, because, owing to considerable widening of the gauge—4ft. 9⅛in.—on curves of small radius as at sidings, locomotive sheds, &c., the blind wheel might fall inside on the ballast in case of a slight defect in the permanent way. To prevent this, the practice is simply to turn the flanges of the driving wheels thinner, so that it does not come into contact with the rail on straight sections or easy curves. I believe this practice was started in Great Britain.

(To be continued).

The Basic Open-hearth Process.*

By B. TALBOT.

Just before the advent of the basic process, or a little over fifty years ago, A. L. Holley, the most noted American metallurgist and steel works engineer of his day, wrote in one of his reports in summing up his conclusions about the open-hearth process, as follows :—

"While the Bessemer process has reached a high degree of perfection, so high, indeed, that the directions of great improvement are not obvious, the open-hearth is availing itself of new accessories in every direction. The Bessemer looks back to a splendid development. The open-hearth looks forward to a splendid development. The open-hearth process is about entering upon a development which will largely increase the use of steel, not only as a substitute for wrought iron and cast iron, but with new adaptations and in new directions."

The late S. T. Wellman once recalled a prophecy by Holley that the open-hearth process would some day go to the funeral of the Bessemer, and Holley certainly anticipated a much greater future development in the open-hearth than in the Bessemer.

Mr. Edward Williams stated in his presidential address in 1879 that the world's production of open-hearth steel in 1878 was 350,000 tons, which was all acid. The total world production of steel ingots and castings in 1927 was 99,090,000 tons, of which 12,100,000 tons were acid and 83,880,000 tons were basic, the remainder being steel made in the electric furnace or in small converters. Of the 83,880,000 tons of basic steel, 64,180,000 tons were made in the basic open-hearth.

When we see the enormous increase in consumption of steel in fifty years, and especially how the output of the open-hearth process has grown in this period, it shows that Holley was correct in his forecast of the increase in the uses of open-hearth steel. As to the statement credited to him by S. T. Wellman that the open-hearth steel process would attend the funeral of the Bessemer, the time has not yet arrived to make even tentative arrangements for its obsequies. In fact, it looks as if both processes will work together for an indefinite period, as there is room for both, so long as the cost of producing basic Bessemer steel is less than that of basic open-hearth, and there may be some purposes for which Bessemer steel is preferred.

Holley's report was written before S. G. Thomas announced to the world his epoch-making invention, in his paper read in the spring of 1879, in which he proved that he had successfully de-phosphorised pig iron in a basic-lined converter, and had produced a satisfactory quality of steel. This great invention stopped all further development of mechanical puddling, as well as the work on preliminary de-phosphorising, which had been solved by Sir Lowthian Bell in this country and by Krupp in Germany in their washing processes. When Thomas invented the basic process he had the benefit of the engineering experience and skill of Bessemer, Holley, and others. His task was to perfect his basic lining, make it more durable, and find out the exact composition of the liquid metal which gave best results in the converter, just as Bessemer had to do in his early experiments.

As soon as it was seen that the basic process was a success in the converter, it was taken up by those who were interested in the Siemens open-hearth process, and here, again, a furnace was at hand ready to be adapted. The Siemens furnace in use at that time, as designed for the acid process, gave sufficiently good results, but it was soon found that with a basic hearth it was very expensive to maintain and repair. The gas and air ports and uptakes were too near together, and air spaces for cooling were inadequate. No doubt if the Siemens patents were investigated we should find more satisfactory designs, but at that time the limited amount of available capital made it extremely difficulty to experiment with larger furnaces of different designs. The pioneers of the basic open-hearth process, however, soon found the old design unsatisfactory in practice, and modified forms of furnaces were introduced.

In Staffordshire, about 1884, Mr. Wailes began to produce basic open-hearth steel at the Patent Shaft Works, but he used a most impure pig iron, which made the operation difficult and expensive. Lincolnshire pig iron at that time, although more expensive than cinder pig iron, would have yielded more economical results. Mr. J. H. Darby about that time erected basic open-hearth furnaces at Brymbo, and having blast-furnaces under his control was able to make a basic pig iron low in silicon and sulphur suitable for the process, and credit is due to him for some of the most important pioneer work done. His method for making high-carbon steel by the addition of solid carbon was a most important step in the development of basic open-hearth practice, and it is now in use in almost every basic open-hearth plant which produces rail and medium carbon steels.

I became interested in the process, and commenced work with it in 1887. At the outset I found that Staffordshire common cinder pig was a very difficult metal to employ, as hours were taken to bring the phosphorus and sulphur down to satisfactory limits. To overcome this, I used two furnaces, the first to melt the pig iron, desiliconise, and remove some of the phosphorus; the second to finish off the heat. The furnaces were small, being of only 2 to 3 tons capacity, and the following gives the history of a typical heat :—

From 2 to 3 tons of cinder pig were charged with oxide and lime and melted in the first furnace, the analysis of the iron being as follows :—

	C. %	Si. %	P. %	S. %	Mn. %
As charged cold into first furnace ..	3·0	1·46	3·96	0·24	1·40
As poured into second furnace	2·00	Trace	2·60	0·09	0·15
Steel as tapped ..	0·09	Trace	0·07	0·054	0·46

The steel was tapped two hours after pouring the refined metal into the second furnace. By working in this way it was found that heats were made in less time, the heavy expenditure on repairs was greatly reduced, and the steel produced was of better quality.

Good work was being done in one or two other works in England where the basic open-hearth process had been introduced. About 1889–90 Mr. Mannaberg started the process on a considerable scale at the new steel works put down by the Frodingham Iron Company and erected under his supervision. The pig iron made from Lincolnshire ores was very suitable for the process, and steel of excellent quality was produced, which did much to convince engineers that basic open-hearth steel was a reliable and satisfactory material for general engineering purposes.

* Iron and Steel Institute. Presidential address. May, 1928. Abridged.

These works were the first in England to erect a tilting furnace to operate the continuous process.

In 1890 I went to America to introduce the manufacture of basic open-hearth steel in the Southern States. In going through various works there, I found a great development in open-hearth basic practice going on. The Homestead works were putting in a large installation for those days.

In the development of the acid open-hearth in the United States it was fortunate that they had a man of such ability and practical experience as the late S. T. Wellman as a pioneer. What Holley had been to the acid Bessemer, Wellman was to the open-hearth. In 1887 he built at the Otis Steel Works, Cleveland, Ohio, a furnace in which he departed from the Siemens design then in use, and, in my opinion, made a great advance by arranging cinder chambers under the uptakes of the ports, and by moving the regenerators forward, so that the slag could not drop amongst, and rapidly clog up, the spaces between the checker bricks, and also by carrying the weight of the furnace body on girders supported on brick columns independently of the regenerator arches. Shortly afterwards basic open-hearth furnaces were built in the United States on these lines. In fact, one may say that this furnace became a new standard design, and very little alteration was made in the design of fixed basic open-hearth furnaces from about 1895 until comparatively recently, except in the arrangement of the ports, and, of course, in size, with the necessary increase in strength.

While these basic open-hearth furnaces were being introduced, S. T. Wellman brought out a further great improvement, namely, the charging machine—perhaps his greatest invention. This machine made it possible for furnaces of much larger capacity to be easily and rapidly charged, and did away with a large amount of manual labour. It was also a great boon to the furnacemen during the high temperature of the summer months. At that time the small electric motor was coming into use at steel works for all secondary power, superseding small steam engines and hydraulic power. In fact, those who witnessed these changes in the decade of 1890–1900 would say that the electric drive for charging machines, overhead cranes, roller tables, machines, and tools in steel works was largely responsible for increasing output and decreasing costs.

H. H. Campbell was the first to use tilting open-hearth furnaces, having put them into operation at Steelton, Pa., in 1889. These furnaces tilted centrally, but, as the block was fixed, a space had to be left open between the tilting and fixed portions. It was in 1895 that S. T. Wellman built his rolling furnace for the Illinois Company, Chicago. In my experiments in 1891–92 on desiliconising the siliceous pig iron in Alabama in fixed furnaces, I had become interested in the tilting furnace, and I had recommended the introduction of a large basic-lined tilting furnace to run continuously for the purpose of desiliconising the siliceous blast-furnace metal by means of a basic slag instead of using an acid Bessemer converter for the purpose.

When I decided to build a tilting furnace for the continuous process, I looked into the merits of these designs, and finally selected Wellman's method of rolling forward instead of tilting centrally, as being the better for the purpose. We did not care for the cylindrical shape of the body of the furnace as built at the Illinois Steel Works, and decided to design the furnace ourselves with flared or sloping sides. As it was decided to have close joints between the tilting sections, movable ports with water-cooled chills and capable of being moved backwards and forwards were used. The flared sides were introduced for the double purpose of more easily repairing the back wall and slag line, and for holding the side walls—especially on the charging side—more firmly when tilting. Also, during slag line and wall repairs, the angle of the wall could be varied by tilting the furnace as desired. The continuous process being very well known, it is unnecessary to say more about it, except that, when first introduced, some authorities prophesied dire results as to heats going through the bottom, but since the process has been in operation I have never heard of any heats having broken through the hearth proper.

The other interesting development in the continuous process was the bringing about, when desired, of the carbonic oxide reaction, in which the carbon in the bath is rapidly oxidised simultaneously with the phosphorus.

Since 1899 numbers of tilting furnaces gradually increasing in size up to 250 tons capacity and of different designs, with and without sloping sides, both centrally tilting and rolling forward, have been built in many steel-making countries, and opinions vary as to which design is the better, the tilting or the rolling furnace, as they both give satisfactory results. Personally, I must say I favour the tilting furnace of, say, 200 to 250 tons, as against the fixed furnace of large size. The hearth in a tilting furnace of large capacity can be much more easily controlled, and the facilities for repairs are much greater than with a fixed one, and for ease of removal of slag there is no comparison. Again, another advantage which the tilting furnace has over fixed furnaces of very large size is that it enables the use of smaller ladles; the pouring of the steel is, therefore, effected through smaller nozzles than is possible where ladles of 150 tons have to be used, and it must be admitted that this factor has an important effect on the satisfactory rolling of the steel.

Of course, there are not many fixed furnaces of even 150 tons capacity, but in large works the tendency is to increase the size. There seems to be now no adequate reason why tilting furnaces of over 300 tons capacity should not be used, especially in large works, and I hope to see them gradually installed.

It is somewhat significant that Holley, in his report of fifty years ago, outlined preliminary refining operations for the acid open-hearth process, and through the period of the development of the basic open-hearth process preliminary refining has been more or less used.

A modification of the basic open-hearth process, known as the Bertrand-Thiel process, was introduced in Germany about 1896. This consisted essentially in the use of two Siemens furnaces working in combination. One was known as the primary furnace, into which the pig iron, oxides, and lime were charged and melted; the other as the secondary furnace, which received the refined liquid metal from the primary furnace. In a later development of the process fluid metal from the blast-furnace was introduced into the primary furnace. By keeping the heat in the primary furnace comparatively low, the phosphorus is very largely removed in this furnace, whilst the carbon remains at about 2 per cent., and this constitutes one of the chief advantages of this modification of the process.

The Hoesch process was another method for effecting the same object. The first slag was separated by tapping the metal into a ladle, and the metal was then returned to the same furnace without the slag.

Monell, in America, charged adequate quantities of oxide of iron and limestone, preheated them, and then poured in liquid blast-furnace metal, refined it, and flowed off the slag.

The so-called "duplexing" method is used largely at times in the United States, in which an acid Bessemer converter is employed to desiliconise and more or less decarbonise metal containing too much phosphorus for acid working. By this means very large outputs have been obtained when working in conjunction with furnaces of 200 tons capacity, an output approaching 5000 tons per week having been produced from a single furnace. We hear also of outputs of 2000 tons per week per furnace both in Germany and in the United States from large fixed and tilting furnaces, using scrap and liquid metal as a charge. When we think of the weekly outputs of the pioneers in the basic open-hearth, which forty-five years ago would be under 100 tons per week per furnace, the present outputs indicate the world's progress.

In my new design of open-hearth furnace with auxiliary hearths—see illustration—the auxiliary hearths are mounted on a frame with wheels, so as to give a longitudinal movement for the double purpose of opening the joint of the furnace when tilting, and also for the rapid removal and exchange when desired of the movable water-cooled throat section A, which contains both the gas and air ports. Three are now in operation.

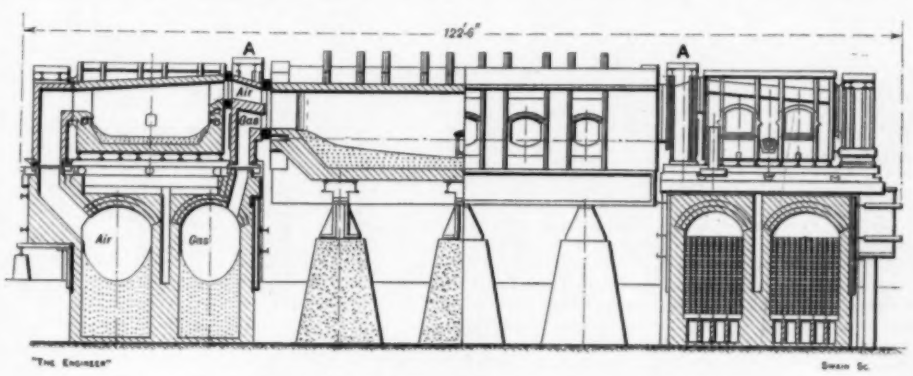
The objects aimed at in the design are to enlarge the hearth area in one unit, to increase output, to decrease repairs, and to reduce costs. A radical departure has been made from the standard furnace in use to-day by the introduction of auxiliary hearths which are used to melt the solid pig iron of the charge when cold pig is used. In furnaces which use a large percentage of scrap, say, 60 per cent., the 40 per cent. of pig iron is melted in the auxiliary hearths, and when required it is tapped and poured into the heated scrap charge in the main hearth. In those works where liquid blast-furnace metal is available, it is poured into the auxiliary hearths, partially refined, the temperature increased, and the metal is then tapped and poured into the main hearth to be worked down into finished steel.

It will be seen in the drawing that, in order to augment the heat available from the main hearth in the auxiliary hearths, gas jets are used when melting or refining liquid pig iron. When in use these gas jets are preferably reversed with the furnace, so that all the gas streams run in the same direction.

Perhaps the idea of mixing and burning a small quantity of gas in the incoming heated air from the regenerator, which further increases its temperature before it burns the gas in the main hearth, is the most novel idea to be observed in the new design. The amount of carbonic acid in the incoming heated air—due to the combustion of the gas in the auxiliary chamber—is inconsiderable, averaging only about 3 per cent. when producer gas is used, and we have experienced no difficulty in obtaining combustion of the gas and all the necessary heat required for rapidly working the charge in the main hearth. On the outgoing end gas is used when required in the auxiliary hearth, with or without air as may be necessary.

The results obtained during the past few months are considered satisfactory, as without increasing the area of the centre or main hearth the output has already been increased by at least 50 per cent. in those furnaces which are working the same mixture of cold pig iron and scrap as they were before. The furnace which is being supplied with liquid blast-furnace metal has increased its output by more than 33 per cent., and a greater increase is expected as soon as a larger area in the auxiliary hearths is available. Of course, these auxiliary hearths can be added to large fixed furnaces when there is sufficient space between them.

The fact that 64 million tons of steel ingots were produced last year by the basic open-hearth process conclusively proves that the steel is in every way suitable for general engineering purposes, otherwise it would not be accepted by engineers all over the world. The future manufacture of steel can be left with confidence to our successors, as they will have a greater knowledge and larger opportunities than we have had, but they will have new problems to solve. Possibly the greatest problem of all is to prevent, as far as possible, the ravages of corrosion in steel structures, and if this cannot be entirely prevented, we must all work to mitigate it as much as is commercially practicable.



TALBOT OPEN-HEARTH FURNACE WITH AUXILIARY HEARTHS

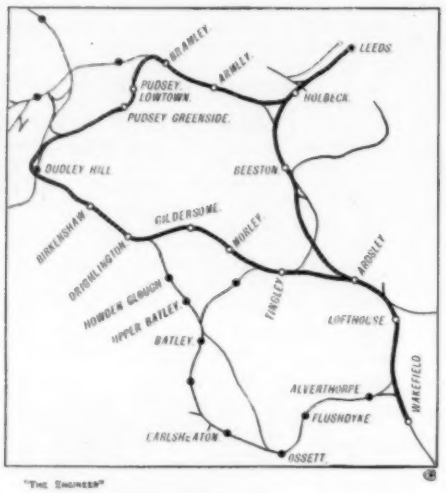
NEW DESIGN OF TIN-SMELTING FURNACE.

METALLURGISTS in South Africa are reported to consider that the position of the tin-smelting industry may be considerably modified by the introduction of a new design of smelting furnace devised by Mr. W. J. Cayzer. At the present time, while South Africa is producing some 2000 tons of tin in concentrate form each year, it is importing approximately the same amount of metal in block, bar and ingot form, in the same period, and the operation of the Cayzer furnace on African raw material will, it seems, permit South Africa to meet its own requirements in the finished material from local resources with considerable saving in expense and elimination of a great deal of carrying to and fro of the materials. An experimental furnace, with a capacity of 1 ton a day has been operated successfully for months and dismantled. This trial furnace is now to be reassembled and demonstrated to a syndicate which has reports and estimates for a 10-ton unit. The designer is satisfied that the process is proved, and the various producers are naturally willing to entrust the smelting of their concentrates to the syndicate as soon as the final demonstration has led to the erection of a furnace on a commercial scale. The Cayzer furnace's essentials are a revolving hearth filled at the outset with metallurgical coke and above it an enclosure containing three Carbo-frax tubes, which radiate heat to the hearth, together with feeding and rabble-ing apparatus. The necessary heat is supplied by radiation, the three tubes of Refrax being fired by crude oil or coal gas to the temperature required in the furnace, 950 deg. Cent., feeding at the same time fine coal to build up the CO gas, which should be at least 60 per cent. When the required temperature is reached, the tin concentrate, mixed with 15 per cent. of fine coal, is fed through a worm conveyor to the centre of the furnace. The reduction takes place almost immediately, and the molten tin acts like mercury, the globules of tin going together and filtering through the bottom of the furnace. It is claimed that the control and maintaining of the proper ratio of the CO content in the furnace is a most important point, and without that control the recovery of standard tin is impossible. Under the proper conditions and using the specially designed furnace, the operation of smelting the tin ore or concentrate takes from 15 to 30 minutes to effect recovery of metallic tin. The designer estimates the fuel cost should not exceed £1 per ton of concentrates treated. The furnace can be designed for any capacity up to 16 tons per diem.

G

The Kitson-Still Locomotive.

THROUGH the courtesy of the London and North-Eastern Railway the Kitson-Still locomotive was able to make trial runs with a complete train on Sunday last. The route had been selected by Mr. Gresley to give the engine a thorough test, and the time schedule to which it had to work was a close one. The route is shown by the map reproduced below, and the stiffness of the climbs may be appreciated from the profiles. The time-tables show both the schedule times and those to which the train actually worked. The train throughout consisted of a six-wheeled observation car immediately behind the engine and six articulated coaches, each pair being carried on three bogies. The total weight behind the draw-bar was approximately 118 tons. There were no ordinary passengers, but a fairly large party of



TRIAL ROUTE

observers, both for the builders and the railway company, the latter being represented by Mr. D. Gracie, District Superintendent.

The first trip was a nominal non-stop from Leeds to Wakefield. Owing, however, to relaying work at Wrenthorpe there was a delay of several minutes, for which due allowance is made in estimating the net time. The return trip was made *viâ* Tingley and Pudsey, and was also non-stop to Holbeck. This run had been arranged to test the engine over relatively long stretches without stops and up to a maximum schedule speed of 41 m.p.h. The total length of the circuit, however, is only a little over 31 miles, and the longest run without check was about 10 miles.

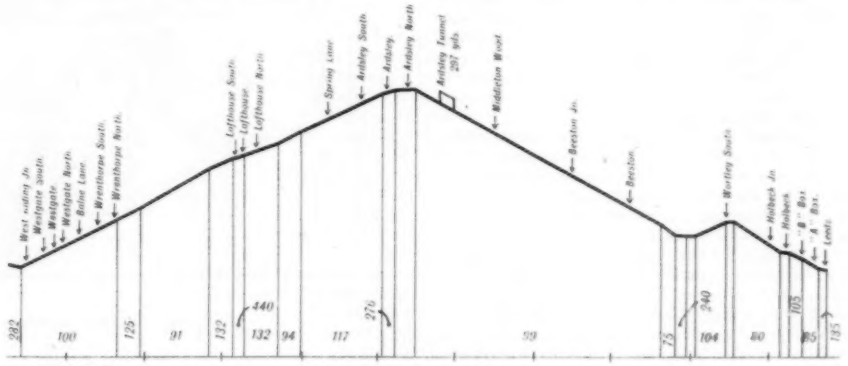
The second trip was more difficult for an engine of the Kitson-Still type, for not only is a great deal of the road very difficult, part of it reaching 1 in 50 up, but stops were arranged at quite short intervals.

On neither run did the engine maintain the schedule

THE KITSON-STILL LOCOMOTIVE

KITSON AND CO., LTD., LEEDS, BUILDERS

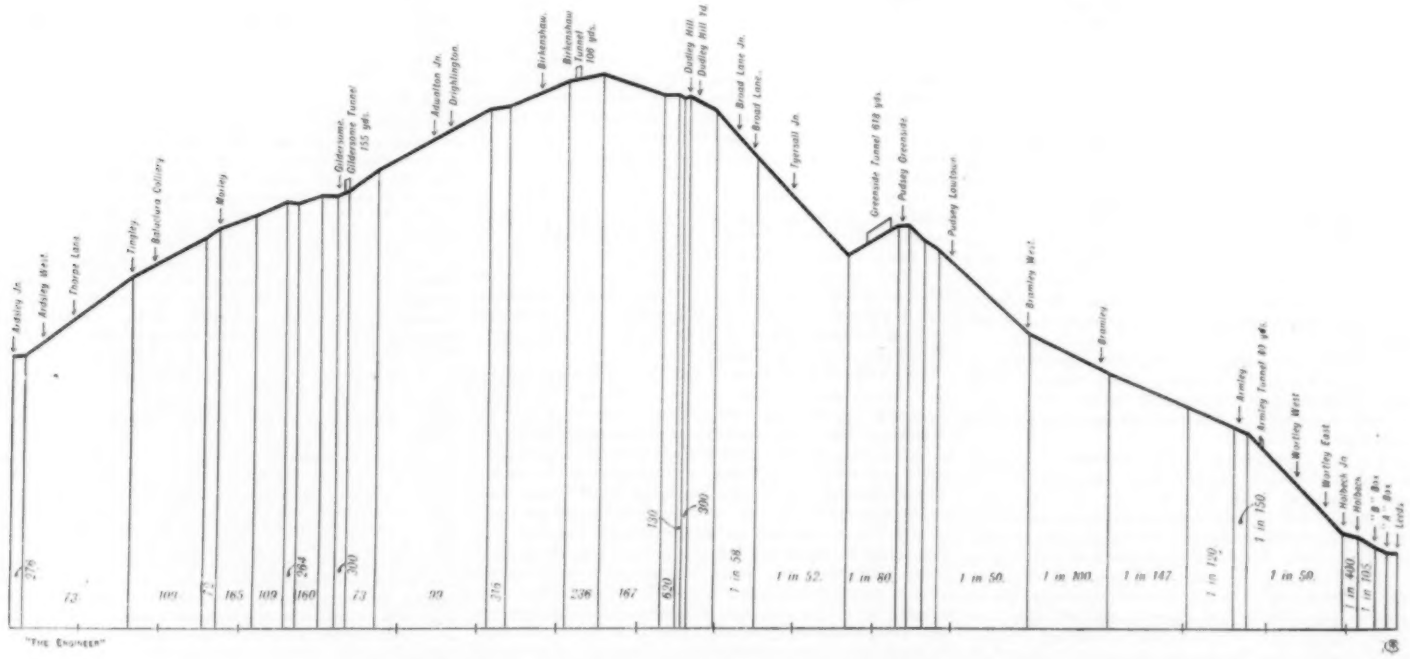
dead centres, and had to set back before she could get away. As the reversing gear, hand operated, is slow in action there was material loss of time on this account. The steam valves are set for a maximum



PROFILE OF LINE LEEDS-WAKEFIELD

cut-off of 65 per cent., and we understand that, as a result of the tests, the cut-off will be increased to 75 per cent. If that is done there should be less chance of the engine stopping at a position from which

wheels is an odd figure the driver has nothing to guide him in bringing the engine to rest. In an ordinary steam locomotive he might watch the coupling rods, for example, but in this engine the rods do not show the position of the cranks. It may, moreover, almost be regarded as bad luck that the engine should so often have stopped in a position in which the cylinders could not get enough steam to start. In one case the



PROFILE OF LINE LEEDS-ARDSLEY *via* TINGLEY AND PUDSEY

times, but on the first she only lost three and a-half minutes, and on both she demonstrated her ability to haul the train and the ease with which she can be handled. On the first trip she stopped in one station, and in the second trip in two stations on

she cannot be started in forward gear; but as a power-operated reversing gear is also to be fitted the delay will be less even should that mischance occur. It is, by the way, interesting to note that owing to the fact that the gear ratio between the engine and the

trouble appears to have arisen from an error in handling, the engine having been allowed to run for a mile and a half on steam alone. That brought down the pressure as well as involving the rapid introduction of feed. Before the head of steam could

be recovered another stop had to be made and the pressure in the boiler at the actual position of the cranks was not sufficient to start the train.

In other respects the engine behaved admirably, though we are inclined to think that for such a service as that worked on Sunday afternoon a larger boiler would be required. It must be remembered that the engine has to be started by steam and that the internal combustion ends of the cylinders do not come into arise, and there is no reason to doubt that the engine could have kept close to schedule times. She represents such an interesting development and offers such possibilities of success that we venture to express the hope that Mr. Gresley will find it possible to put her into a service better suited to her characteristics.

No attempts have been made so far to measure the fuel consumption. That will only be possible when the engine gets into regular service; but already,

KITSON-STILL LOCOMOTIVE.—EXPERIMENTAL TRAINS, LEEDS TO WAKEFIELD, &c., SUNDAY, APRIL 29TH, 1928.

Train Working Details.—9.50 a.m. Leeds to Westgate.

Mileage M. C.	Stations.	Booked times. Arr.	Booked times. Dep.	Actual times. Arr.	Actual times. Dep.	Minutes late at each station. Arr.	Minutes late at each station. Dep.	Length of each delay, mins.	Cause of each delay.
0 0	Leeds (Central)		9.50		9.51		1	1	Late, arr. coaches
	Beeston Pass			9.57			1	1	Loco., Holbeck to Ardsley
5 48	Ardsley	10.2		10.4			2		
	Ardsley (Spring Lane)			10.6	10.7			2	Caution, single line wkg.
	Lofthouse			10.10			4		
3 53	Wrenthorpe S. Junc.		10.12	10.13½	10.16½	4½	4½	½	Single line working
0 60	Westgate S. Junc.		10.15					½	Single line working
	Westgate	10.17							
	Westgate N. Junc.			10.19		5			Engine detached, saloon and train lowered into station
10 1									

Train arrived, saloon and engine reversed, water taken, and train ready to leave at 10.35 a.m.
Weather fine. Rails dry.
Load, six-coach set and engineer's saloon (about 118 tons).
Remarks.—Total time lost by engine, 1 minute.
Same time allowed as for an express train under ordinary railway conditions.

11.10 a.m. Westgate to Leeds (viâ Tingley and Pudsey).

0 0	Westgate		11.10		11.10			1	Wrenthorpe South, setting down pilot man
	Lofthouse Pass				11.17				
4 24	Ardsley	11.18			11.21½		3½	2½	Lost by locomotive
	Tingley				11.25				
	Morley				11.28½			5½	Lost by locomotive
	Gildersome				11.32½				Ardsley to Adwalton
5 39	Adwalton Junc.	11.26			11.35		9		
	Birkenshaw				11.38			2	Engineer's caution
	Dudley Hill				11.41½				
4 2	Broad Lane Junc.	11.33			11.43		10		1 min. regained by loco.
0 30	Tyersal Junc.	11.31			11.44		10		
	Greenside				11.46				3 min. regained by loco.
	Lowtown				11.47				Tyersal Junc. to Holbeck
3 30	Bramley West	11.41			11.48		7		
	Armley				11.53			2	Engineer's caution, Bramley to Armley
	Wortley West				11.54½				
3 27	Holbeck	11.47	11.48	11.56	11.56½	9	8½		
0 41	Leeds (Central)	11.59		11.58		8			½ min. regained by loco.
21 33									

Weather fine, rails dry.
Load, six-coach set and engineer's saloon (about 118 tons).
Remarks.—Total time lost by engine, 8 min.; total time regained by engine, 4½ min.; net time lost by engine, 3½ min.
Same time allowed as for an express passenger train under ordinary railway conditions.

12.40 p.m. Leeds to Westgate.

0 0	Leeds (Central)		12.40		12.45		5	5	Late start, waiting engine
0 41	Holbeck		12.43	12.46½	12.47	4½	4		½ min. regained by engine
1 76	Beeston		12.48	12.52	12.54		6	2	Engine reversing to start
3 11	Ardsley	12.54	12.55	1.2	1.2½	8	7½	2	Lost by engine
	Ardsley (Spring Lane)							1	Caution. S.L.W.
1 69	Lofthouse		1.0	1.7	1.7½		7½		1 min. regained by engine
	Wrenthorpe N. Junc.							1	P.W. caution
1 64	Wrenthorpe S. Junc.		1.7	Pass	1.12		5		Train ran direct into up platform instead of viâ Westgate South, as up line released by engineer
0 60	Westgate S. Junc.		1.10						
	Westgate	1.12		1.15		3			
10 1									

Weather fine, rails dry.
Load, six-coach set and engineer's saloon (about 118 tons).
Remarks.—Total time lost by engine, 4 min.; total time regained by engine, 1½ min.; net time lost by engine, 2½ min.
Total time lost by P.W. cautions, 2 min.; total time regained at stations, 1 min.
Same time allowed as for a similar train under ordinary railway conditions.

1.40 p.m. Westgate to Leeds (viâ Tingley and Pudsey).

0 0	Westgate		1.40		1.40				
2 34	Lofthouse		1.46	1.46½	1.47		1	1	Lost by engine
								1½	Lost by engine
1 69	Ardsley	1.50	1.51	1.52½	1.54½	2½	3½	1	Engine reversing
								1	Lost by engine
1 40	Tingley		1.55	1.59½	2.1½		6½	2	Engine reversing
1 18	Morley		1.59	2.5	2.6		7	½	Lost by engine
1 42	Gildersome		2.3	2.10	2.10		7		
1 29	Drighlington		2.7	2.14	2.14		7		
									1 min. P.W. Ctn. Birk'shw
1 14	Birkenshaw		2.11	2.18	2.18½		7½		½ min. regained by loco.
1 67	Dudley Hill		2.15	2.23	2.23½		8½	1	Lost by engine
0 72	Broad Lane Junc. Pass	2.17			2.25½		8½		
0 30	Tyersal Junc. ,,	2.18			2.28		8		½ min. regained by loco.
1 37	Greenside		2.21	2.28½	2.29		8		
0 52	Lowtown		2.24	2.31	2.31		7		1 min. regained by loco.
1 21	Bramley Pass		2.26		2.33½		7½		
	Wortley West ,,				2.38				½ min. P.W. Ctn. Armley
3 27	Holbeck	2.32	2.33	2.39½	2.40	7½	7		
0 41	Leeds (Central)	2.35		2.41		6			1 min. regained by loco.
21 33									

Train did not stop at Bramley or Armley and 3 min. allowed for this purpose in the circular have been deducted in computing the actual number of minutes late.
Weather fine, rails dry.
Load, six-coach set and engineer's saloon (about 118 tons).
Remarks.—Total time lost by engine, 8 min.; total time regained by engine, 3 min.; net time lost by engine, 5 min.
Same time allowed as for a similar train under ordinary railway conditions.

action until she is well away. Frequent stops, therefore, make a heavy call upon the boiler. But, furthermore, steam is needed to co-operate with the internal combustion when stiff climbs have to be undertaken. It is only necessary to look at the profiles to see the nature of the collar work on the route selected, and to understand that the boiler was called upon to supply a good deal of steam. On a road with easier gradients and with longer intervals between the stops the same trouble would not with increasing knowledge, the amount of oil consumed has been materially reduced, and there is no reason at all to doubt that in a service which made the use of steam less constant the thermal efficiency of the internal combustion side would become effective. It may be useful to remind our readers that drawings and a full description of the engine were given in a paper read by Lt.-Col. Kitson Clark before the Institution of Mechanical Engineers and reproduced in THE ENGINEER of April 15th and 22nd, 1927.

Travelling in the observation car, in the cab, and on an observation platform built in front of the smoke-box, we were able to observe the working of the engine fairly closely, and we were certainly favourably impressed. The employment of steam makes the handling as easy as that of a normal locomotive, and we observed that there was no difficulty in backing on to a train or carrying out the usual manœuvres. The train started well and appeared to accelerate quickly, the cylinders starting to fire at a slow engine speed. Apart from reversing, to which we have already alluded, the driver seemed to have no difficulty in handling the train. The reversing gear is operated by two hand wheels, one of which controls the steam and the other the internal combustion valves. As the gears have to be independent so that the steam may be notched up, the two hand wheels must be revolved separately, and that takes time. That, however, is a detail which can be improved, and it does not in any case affect the principle on which the engine is designed.

As far as the construction of the locomotive is concerned, we need scarcely say that it is a very fine piece of work, and the appearance is far better than those who have only seen the illustrations might suppose. If we were inclined to be critical of a perfectly new design, we should say that the boiler is on the small side. A locomotive, as a rule, has to be able to do whatever it is asked to do—within rather wide limits of reason—and whilst we see no reason to doubt that the Kitson-Still No. 1 could deal quite adequately and economically with many services, it does not with its present boiler possess that flexibility which characterises the normal engine. One never looks for perfection in the first of any mechanical engineering production; experience always suggests modifications and improvements. Kitson and Co., Ltd., and the designers have to be congratulated on the production of a perfectly novel locomotive which even now, only a few months after completion and without the advantages of complete tests, is quite capable of taking her position in a regular link.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

AUTOMATIC SUB-STATIONS.

SIR,—I have read with considerable interest Mr. Whitaker's letter in your issue of April 20th.

I am afraid some of his statements in regard to rectifier practice are now out of date in the light of recent experience, while evidently he has not yet fully grasped the possibilities and the advantages of the high-power rectifier as a converter. To-day, the rectifier is quite capable of holding its own with any other form of converter for the case of the general supply, while it has proved itself superior for traction conditions.

The reasons given by Mr. Whitaker for the preference shown for rotating machinery in some of the railway electrification schemes that have already been carried out, hardly reflect the true position. The schemes in question were formulated several years ago, before the rectifier had reached its present state of development, and before sufficient working experience had been gained with those installed at that time to warrant any considerable risk being taken by installing such new plant on a large scale. To show that this period of uncertainty has been passed, two typical examples may be quoted. The first is that of the electrification of the main line between Rotterdam and Amsterdam, for which nineteen rectifier equipments, having a total output of 20,500 kW at 1500 volts were provided. They are contained in seven sub-stations, of which six are automatic. The second case concerns the electrification of the Berlin Metropolitan Railways, for which one hundred and twenty-five rectifier equipments were ordered, totalling approximately 150,000 kW.

It is reasonable to suppose that the engineers responsible for the placing of the above contracts will have satisfied themselves as to the absolute suitability of the rectifier for their requirements, and that telephone interference and the other questions to which Mr. Whitaker alludes, will have been given the consideration they deserve.

R. L. MORRISON.

London, S.W. 1, April 28th.

A NEW company, which proposes to utilise coke oven gas for the synthetic manufacture of fertilisers, and which is called the Ruhr Chemical Corporation, has been formed by a consortium of twenty-seven of the leading coal and coke companies of the Ruhr, headed by the Vereinigte Stahlwerke A.G. Large plants which are to be capable of an annual production of 300,000 tons of synthetic nitrate are at present in course of construction. The principal plant at Holton, near the Rhine, will, it is understood, be in operation early next year, and nine months later a second unit is to be started, to be followed later by several others. The processes used will be the Concordia-Linde and the Casale processes for the production respectively of hydrogen and synthetic ammonia. The present surplus of coke oven gas in the Ruhr is estimated at over 9000 million cubic metres annually, which, if fully utilised, is equivalent to an annual production of 1,800,000 tons of synthetic nitrate, *i.e.*, three times Germany's present output. Other important coke oven gas derivatives include a methyl petrol substitute, which it is intended to produce on a large scale.

Electrical Equipment of the Singapore Floating Dock.*

By ERNEST T. WILLIAMS.

THE Singapore Floating Dock† has a lifting capacity of 50,000 tons, and is shown in outline in Figs. 1 and 2.

Its length is 855ft., width 172ft. and 50ft. high from the pontoon deck. It contains no less than 20,000 tons of steel, and 3,500,000 rivets were used in its manufacture. Its building and equipment in approximately twelve months constitutes a record, and is a valuable testimonial to British Engineering.

The ship indicated in the dock by broken lines in Fig. 1 is H.M.S. "Hood," Great Britain's largest battleship.

Electrical Lay-out.—In considering the electrical equipment of the floating dock, it should be borne in mind that in reality, it is a self-contained miniature dockyard, in so far that it is capable of undertaking the docking and repair of the largest ships and supplying these vessels with certain essential services while in dock. The tops of the side walls are working q ays, while the upper parts of the interior of the side walls contain workshops, power plant and accommodation for the dock staff. The dock has to be built in sections for launc ing purposes, and these sections have to be capable of b ing taken apart for self-docking purposes, this being necessary for the maintenance of the dock itself. These requirements complicate the conditions which have to be met in designing the electrical installation, which includes :—

(*a*) Pumping plant—dock, fire, drainage and circulating water pumps; (*b*) Ventilation plant; (*c*) Capstans; (*d*) Travelling cranes; (*e*) Air compressors, main and auxiliary; (*f*) Workshops machinery; (*g*) Ice-making plant; (*h*) Arc-welding plant; (*i*) lighting; (*j*) Miscellaneous, including cable installation; (*k*) Supply of electrical energy for charging the batteries of submarines in dock; (*l*) Telephone system; and (*m*) Electro-pneumatic valve control system.

The generating plant is installed in sections 3 and 4—see Fig. 1. In section 3, there is one 1000-kVA turbo-alternator with its auxiliaries and boiler plant, and one 500-kW synchronous motor generator. This plant is installed in the port wall and meets the whole of the alternating-current and direct-current services in sections 1, 2 and 3. Similarly, the generating plant installed in section 4 port wall meets the whole of the electrical requirements of sections 4, 5, 6 and 7. This plant comprises two 1000-kVA alternators and one 500-kW synchronous motor generator.

The Generating Plant.—The generating plant to be installed on a projected dock is governed by three sets of conditions which vary widely, viz.:—

(*a*) *A Ship being Docked.*—In this instance power is required for 1542 B.H.P. of dock pumping plant for about four hours, and a smaller amount of power for capstans, lighting and general dock purposes.

(*b*) *A Large Ship in Dock under Repair.*—In this instance the main pumping plant will not be in use, but all the other resources will be working, including the supply of electrical energy night and day to the ship docked. This condition will extend over many hours per annum.

(*c*) *The Dock Not in Use for the Docking of a Ship.*—In this instance ordinary maintenance work will be proceeding during working hours, but for the remaining time only a small load is expected for essential lighting and ventilation.

After full consideration of the above factors, it was decided that these varying conditions could be met in the best and most economical way for the Singapore Dock by installing :—

Three 1000-kVA three-phase steam-driven turbo-generators, supplied with steam from four boilers—one down for cleaning. The main pumps are driven by 1000-volt, three-phase alternating-current motors.

One 250-kW, 220-volt, direct-current Diesel generator.

One 36-kW, 220-volt, direct-current Diesel generator.

Two steam sets will be ample when the main pumps are in operation as in (*a*) above. The third set can be used as stand-by or to supply the direct-current load through either or both of two 1000-volt synchronous motors driving 500-kW, 220-volt, direct-current generators. After the ship is docked and the main pumps are shut down, as in (*b*), one turbo-alternator operating through the motor generator will probably be used to supply the load during working hours, while after working hours the 250-kW Diesel set will suffice. When the dock is not in general use, as in (*c*), steam will be shut down and the load will be met by the 250-kW set during working hours, and the 36-kW Diesel set after working hours.

Boilers.—The four boilers are arranged in two boiler-rooms, the boiler fronts being towards the centre of each room. Each boiler has its independent uptake and funnel. The boilers are of the Yarrow type, with cylindrical water drums. The working pressure is 235 lb. per square inch, and each boiler is capable of evaporating 20,000 lb. per hour. They are oil fuel fired, the fuel-burning capacity of each boiler being about 2000 lb. of oil per hour through five 400 lb. per hour oil fuel sprayers working at 150 lb. per square inch.

Turbines.—The turbines by Belliss and Morcom are designed for 3000 r.p.m. and for steam at 210 lb. pressure and 27in. vacuum. Each turbine is coupled to a 1000-kVA generator and is capable of an overload of 25 per cent. The two turbines in the after engine-room exhaust into a common condenser below, with shut-off valves intervening. The turbine in the forward engine-room has its own separate condenser below.

Condensing Plants.—The surface condensers are placed in a separate chamber below the turbo-generator room, and divided therefrom by a water-tight deck. Circulating water to each condenser is drawn through the side of the dock by a vertical spindle centrifugal pump, placed well down in the dock chamber, so as to be always submerged, and driven by a single-cylinder steam engine with a vertical crank shaft, erected on the condenser flat. The circulating water discharge pipes also pass down through the flat to below minimum water line, so that a complete syphon system is maintained, the points of intake and discharge for the water being placed as far apart as possible in order to prevent re-circulation of the heated discharge water. The air and condensate extraction is by means of reciprocating direct steam-driven pumps working in conjunction with a steam ejector for the first stage of the air extraction. The surface condensers are by Messrs. Belliss and Morcom, the kinetic reciprocating air pumps by Messrs. Vickers, and the circulating water pumps by Messrs. Drysdale. These latter are referred to in the section on Pumping Plant.

Generators.—The three G.E.C. 1000-kVA, 3000 r.p.m. generators are designed for three-phase alternating current at 50 cycles and 1020 volts between phases. They are of the enclosed type and are ventilated by means of fans attached to both sides of the rotor. The air for the cooling of the generators is made to pass through filters of the dry type, arranged in separate housings and connected to the generators by trunking. The heated air is discharged into the open from trunks applied to the top of the machine. The permissible rise of temperature in the stator does not exceed 33 deg. Cent., and for the rotor 43 deg. Cent., both measured by thermometer. The exciters are of the overhung type and work with a low voltage of between 60 and 70 volts.

Diesel Engine.—The 250-kW Diesel engine by Belliss and Morcom, Ltd., is coupled to a Crompton-Parkinson 225-volt direct-current generator. The engine is of the air injection type, has six cylinders, and operates on the four-cycle, single-acting principle. It is of latest design and

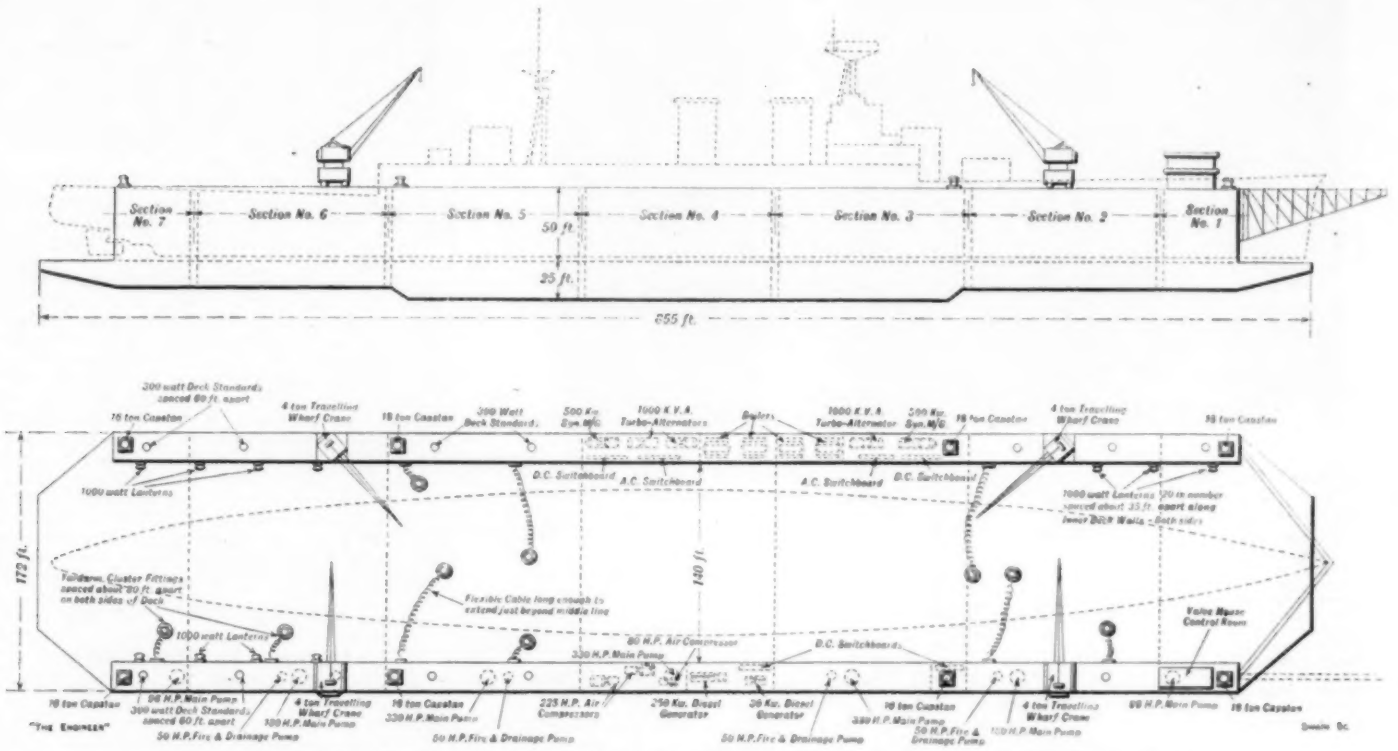


FIG. 1—SIDE ELEVATION AND PLAN OF SINGAPORE FLOATING DOCK SHOWING ELECTRICAL EQUIPMENT

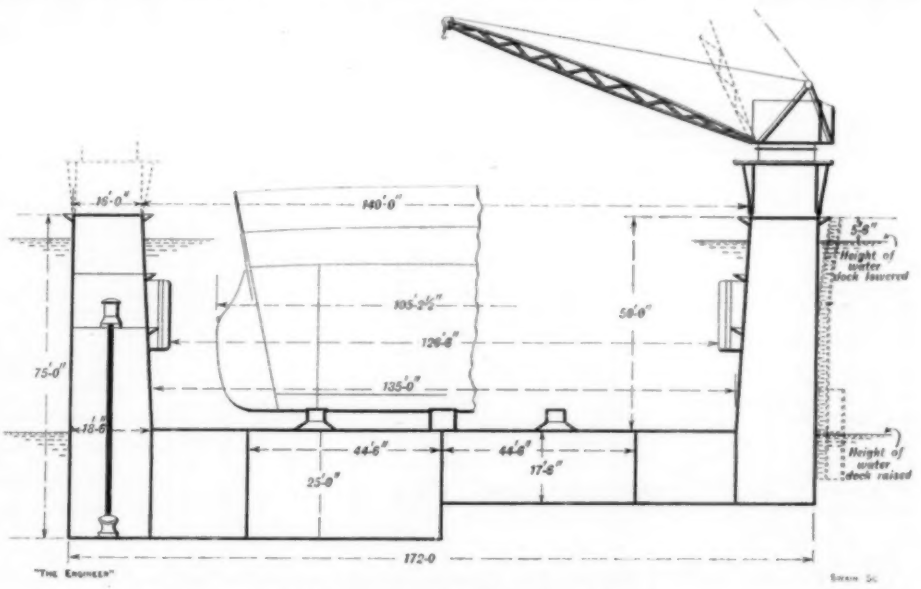


FIG. 2—CROSS SECTION OF THE DOCK

* Abstract of a paper read before the Institution of Electrical Engineers.

† This dock was illustrated in the issue of THE ENGINEER for January 20th, last.

practice, and designed for 375 r.p.m., although at the power required by the dock installation the speed will be reduced to 330 r.p.m.

A three-stage air compressor incorporated in the engine structure supplies the air for fuel injection and for re-charging the starting air receivers. The compressor is fitted with disc valves and has larger intercoolers and an after cooler of the tubular pattern. Separate fuel pumps for each cylinder are provided, and governing is effected by controlling the amount of by-passed fuel through the suction valves. Individual pumps can be cut out as required, and an emergency overspeed governor engages with the pumps and trips the engine at 20 per cent. overspeed. A push knob for an emergency shut down is also provided, the overspeed governor gear being released.

Switchboards.—There are two main alternating-current switchboards, one forward and one aft on the port side. Each is of the sheet steel cubicle type, backing against the bulkhead with hinged doors on the front, on which all the instruments are mounted. The two boards also control the supply to the main pump motors and the two synchronous motor generators, while provision is made for paralleling up the two switchboards by an inter-connector cubicle at each switchboard. A synchronising panel is provided on each switchboard to enable synchronising to be carried out either between the machines or the two switchboards. The main direct-current supply is controlled by four switchboards interconnected by a ring main, consisting of 1·0 square inch P.I.L.C. cables, two per pole. The aft starboard board controls two auxiliary Diesel-driven sets, one of 250 kW and the other of 36 kW, each feeding the 220-volt ring main bus-bars direct. The forward starboard board is purely a feeder board.

Synchronous Motor Generator Sets.—These are of G.E.C. manufacture, and are designed for an output on the direct-current side of 500 kW. The generators are shunt wound and are arranged to give an output of 2270 ampères at 220 volts, when working direct on the power and lighting supply. They have also to be suitable for battery charging at 330 volts when they have to develop an output of 1520 ampères. In emergency they have to be able to supply current at 105 volts up to a maximum of 2850 ampères for the purpose of supplying lighting to a ship where this voltage is used for the electric installation. The motors are of the self-starting synchronous-induction type, capable of an output of 725 H.P., when fed from the 1000 volts, three-phase, 50-cycle supply.

Distribution System.—Over 100 miles of electric cables have been installed. Those for the 220-volt, direct-current system are generally single-core rubber-insulated and lead-sheathed. This general principle has been departed from in a few instances, *e.g.*, the cross dock cables and those connecting the direct-current switchboards are paper-insulated, lead-sheathed and armoured. The alternating-current cables are generally three-core, paper-insulated, lead-covered and armoured. The connections between the two alternating-current boards are, however, single-core cable; the three-core type of cable was departed from in this instance having regard to the comparatively short length involved and to the large diameter cable and trifurcating boxes which would be required. The cables for the control and communication circuits are multi-core, rubber-insulated, and lead-sheathed.

The chief sizes of cables used are:—Paper insulated: Single-core, 1·0 and 0·6 square inch; three-core, 0·2, 0·075 and 0·04 square inch. Rubber-insulated: 1·0, 0·4 and 0·25 square inch single core.

Alternating-current Distribution.—The main pumps are all situated in the starboard wall, one pump to each section, and the horse-powers of the motors range from 330 to 96. As the alternating-current switchboards are installed in the same compartments as the alternators, the cables to the motors are taken across the dock through cable passages specially constructed for their use. There are two such passages, one in each of the sections 3 and 4, and the whole of the cables, alternating-current and direct-current, control and low-voltage cables, pass through them.

Direct-current Distribution.—In order to avoid a large number of cross-dock cables, distribution is given from four switchboards, situated one in each port and starboard wall in sections 3 and 4. These boards are connected by 1·0 square inch, paper-insulated, lead-covered, armoured cables, two per pole, and are supplied with direct current either from the synchronous motor generators, or, when steam is down, from the Diesel generators installed in the starboard wall of section 4. These boards control the supply of the power and lighting services of the dock, also to two connection boxes on each dock wall forward and aft for giving a supply of electrical energy to a ship in dock. A separate panel is provided for the "ship-in-dock" supply, and forms a part of the direct-current switchboard in port side of section 4. A supply of electrical energy is given to this panel, either from the direct-current board itself or from either of the synchronous motor generators through a change-over switch. The arrangement is such that the supply to a ship in dock can be quite separate from the dock installation, so that any "earth" in the ship does not affect the dock distribution system.

Pumping Plant.—The pumping plants installed comprise the following:—(1) Main pumps; (2) Auxiliary pumps; (3) Fresh water pumps; and (4) Fire and drainage pumps.

The auxiliary pumps consist of two feed pumps for domestic boilers, an evaporator pump and a portable oil pump. All the pumps are motor driven, the main pumps being fed from the 1000-volt alternating-current supply, and the other pumps from the 220-volt supply. In addition, there are the main and auxiliary water circulating pumps for the steam-raising plant, which are steam driven. These are of the vertical spindle type, driven by vertical shaft engines. There are in all seven main drainage pumps by Messrs. Drysdale, three of them having 43in. suction and delivery branches, and capable of delivering about 100 tons of water per minute. These are driven by 330 B.H.P. Crompton motors running at 480 r.p.m. There are also two 27in. pumps, each capable of delivering about 66½ tons per minute, driven by 180 B.H.P. Crompton motors, running at 575 r.p.m., and two 20in. pumps each capable of delivering about 33 tons per minute, and driven by 94 B.H.P. Crompton motors running at 960 r.p.m. The pumps are of the vertical-spindle type, arranged with balanced suction. The control gear for the main drainage pump motors, by the Electric Control Company, is of the contactor type, arranged for push-button control from the control room—valve-house—and is fitted with indicating signal lamps.

Evaporator Priming Pump.—This pump is in connection

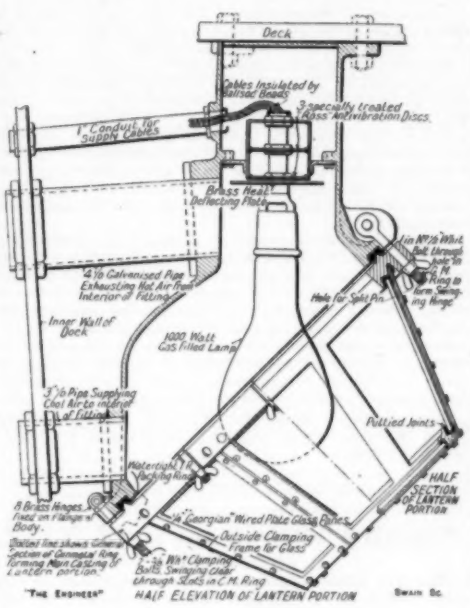

Deck
Cables Insulated by Ballast Boards
1" Conduit for Supply Cables
3 specially treated Glass Anti-vibration Discs
Brass Heat Deflecting Plate
1 in W.I. Bolt through Deck to form Swing-ing Hinge
4" Galvanised Pipe Exhausting Hot Air from Interior of Fittings
Hole for Split Pin
Inner Wall of Dock
1000 Watt Gas Filled Lamp
3" Pipe Supplying Cool Air to Interior of Fittings
Rolled Joints
Watertight Packing Ring
HALF SECTION OF LANTERN PORTION
8 Brass Hinges fixed on Flange of Body
"Georgian" Wired Plate Glass Panes
Outside Clamping Frame for Glass
Dotted line shows Cover or Section of Gunmetal Ring forming Main Casting of Lantern portion
¾" W.I. Clamping Bolts, Swinging Clear through Slots in C.M. Ring
"THE ENGINEER"
HALF ELEVATION OF LANTERN PORTION
Swain Sc

FIG. 3—WATERTIGHT LANTERN

with the evaporating plant by G. and J. Weir, the pump having 8in. suction and delivery branches, capable of delivering about 915 gallons of water per minute. The pump is situated below the water level, so that it is always primed. The electric motor is situated in the evaporator room, connected through suitable lengths of vertical shafting, suitably supported. These electric motors are by Laurence Scott, and are of 23 B.H.P., suitable for 220 volts direct-current supply, and run at a speed of about 1000 r.p.m.

Fire and Drainage Pumps.—There are four fire and drainage pumps, the whole of the equipment being by W. H. Allen, Sons and Co. The pumps are of the vertical-spindle, two-stage, single-suction type, driven by motors through vertical shafting. Two of the pumps, situated in sections 3 and 5 of the dock, are provided with about 44ft. of shafting, while the other two pumps, situated in sections 2 and 6, are provided with about 36ft. of shafting.

The pumps give the following performance:—

	Fire duty.	Drainage duty.
Tons per hour	75	150
Gallons per minute	280	560
Total head from all sources, feet	277	55

Ventilation.—The ventilation of a dock made up of many water-tight compartments is an important consideration, particularly in the Tropics. The ventilation of the machinery, living and working spaces, is effected by means of fifty-four forced draught ventilating fans, the air being delivered by ducts to the various compartments. The fans are of Messrs. Veritys make, the starters being by Bray, Markham and Reiss.

Capstans.—Eight electrically driven and manual power dock capstans are fitted, each capable of exerting a pull of 16 tons at 45ft. per minute, and driven by a 78 B.H.P. motor at 630–700 revolutions, 220 volts direct current.

The capstan head is of cast steel, 2ft. diameter, over the whelps, which are symmetrical at the upper and lower parts and are cast with the head. A powerful "Harfield" differential brake gear of special design is fitted. It is keyed on a solid forged steel vertical spindle, secured against rising, suitably stepped in a bearing of ample area, and fitted with phosphor bronze sleeves where it passes through the weather deck. The deck bearing is of cast steel suitably lined with gun-metal, continued through deck and fitted with stuffing-box below. The capstan is driven by worm and spur gearing, all with machine-cut teeth. A double ball thrust bearing takes the thrust in either direction. The spur gearing consists of a forged steel pinion mounted on the worm wheel shaft and driving a cast steel wheel fitted with a gun-metal bush. The drive from the wheel to the main vertical spindle is through a cast steel coupling plate fitted with two forged steel driving pins. These are removed when working by hand power. Two solenoid band brakes are fitted at one end of the motor. The control gear consists of a relay reversing controller in a water-tight case for mounting below deck, and resistances of the ventilated pattern, partly combined, and partly separate.

Electric Cranes.—Four 4-ton travelling wharf cranes by Sir William Arrol and Co. have been installed, viz., two on each dock wall. The cranes operate on a 220-volt, direct-current supply.

Each crane has four motions operated by separate motors, as follows:—Hoisting, 25 B.H.P. at 600 r.p.m.; derricking, 25 B.H.P. at 600 r.p.m.; slewing, 10 B.H.P. at 750 r.p.m.; travelling, 25 B.H.P. at 600 r.p.m. The motors are of Messrs. Laurence Scott's manufacture, and are of the totally enclosed series-wound reversing type, rated for two hours with a temperature rise not exceeding 33 deg. Cent. for the windings and 38 deg. Cent. for the

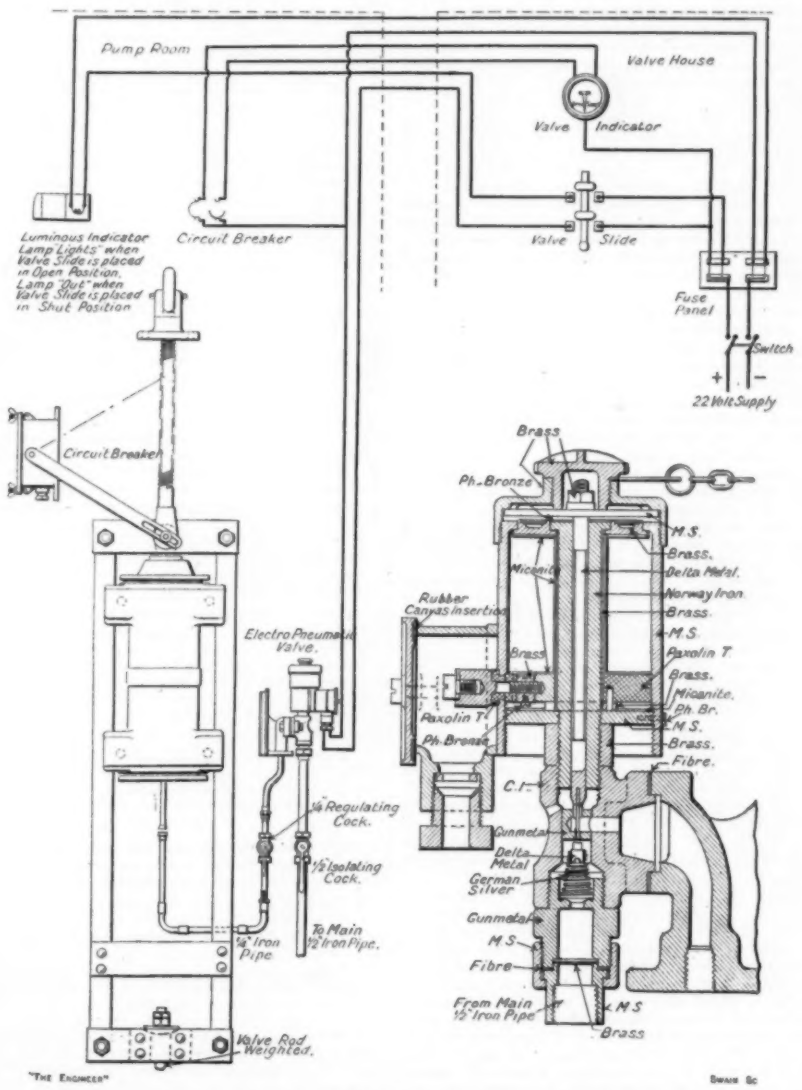


FIG. 4—ELECTRO-PNEUMATIC CONTROL ARRANGEMENTS AND VALVE

commutators. The controllers, of the Electro-Mechanical Brake Company's manufacture, are of the drum reversing type giving plain series control in each direction of motion.

Collectors.—Current is collected by means of collectors pressing against live steel rails running the full length of the dock. The current is fed to the crane panel through a hollow centre post surmounted by a slip-ring collector. This collector has ten rings, two for the main cables, four for the travelling motor and two for the travel limit switch. An isolating switch operated from the deck level is fitted and controls the supply of current to the crane. All motors are fitted with solenoid brakes.

Air Compressors.—The air compressor installation comprises three Reavell air compressors of the vertical double-acting, two-stage type, with intercoolers. These compressors are provided with forced lubrication and valves of the low-lift plate type. Two machines are for a capacity of 1000 cubic feet of free air per minute actually delivered, the speed of the compressors being 250 r.p.m.; working pressure is 120 lb. per square inch, and the B.H.P. required by each machine is 225. The compressors are direct coupled to Laurence Scott motors wound for 220 volts direct-current supply; combination base plates are provided under the compressors and motors. The third machine has a delivered capacity of 350 cubic feet of free air per minute, speed being 350 r.p.m., working pressure 120 lb. per square inch, B.H.P. 77. This compressor is also direct coupled to a Laurence Scott motor, 220-volt direct-current, the set being mounted on a combination base plate.

Workshop Machinery.—The machinery in the workshops is electrically driven, some of the machines being run from line shafting and others having separate motors. The main line shafting is driven by one 15 B.H.P. and one 5 B.H.P. motor of the constant-speed type, running at 500 r.p.m., the motors being mounted as usual on adjustable slide rails. The machines include lathes, and drilling, grinding, screwing machines, &c. The workshop is also equipped with two welding bays, in which are installed one arc-welding plant for general work and one Cyc-Arc welding plant. The plant for general use comprises one motor and two generators, mounted on a bogie suitable for transportation and provided with fittings for lifting.

Lighting.—The efficient lighting of a large dock is important to enable night operations to be carried on economically and without accident. The lighting installation can be divided into two main portions, viz., that for the lighting of the dock itself, and that required in connection with docking operations and for night work. The former calls for no special comment and follows the usual two-wire, rubber-insulated, lead-sheathed system, with water-tight fittings. About 700 lamps are installed. For the lighting of the top of the dock walls, twenty-four lamp standards, 10ft. high, with 300-watt lamps, are employed. These are limited in height to clear the travelling cranes, and are spaced approximately 60ft. apart. The dock walls and the sides of a ship in dock are lighted by 1000-watt lamps housed in the special lanterns shown in Fig. 3. There are twenty in each dock wall, and the fittings are secured to the underside of the top deck projections close to the dock wall. In order to dock a badly damaged ship, it may be necessary to sink the dock to such a depth that some of the lanterns may become submerged. For this reason, a special design of fitting was prepared. The fittings are exceptionally strong and are water-tight, but ventilation for the interior of the lantern is obtained by means of ventilating pipes, which pass through the walls into the interior of the dock.

The total illumination of the dock aggregates to approximately 90,000 candle-power.

Telephone System.—The telephone system consists of a thirty-five-line telephone exchange, and twelve direct line communications.

The exchange is fitted in the Low Power Room, immediately below the Control Room in No. 1 Section, and has connections to all machinery compartments, officers' and men's quarters and shore exchanges.

All telephones fitted are special Admiralty design, as fitted in the latest warships, and are worked on a two-line insulated circuit at a pressure of 22 volts.

The installation, besides being for use in the operation and maintenance of the dock, is also equipped to meet the needs of a ship when docked, and four lines are provided on the dock exchange to connect to the ship's exchange or telephones in special positions in the ship, as may be desired. By this means the ship in dock may be in direct communication with the shore through one or more of the shore lines fitted to the dock exchange.

Electro-pneumatic Valve Control System.—Probably not the least interesting feature in the electrical equipment is that which concerns the control of the dock as a floating structure.

The raising, lowering and trimming of the dock are governed by the water that is pumped from or allowed to flow into the various parts of the structure which, as previously stated, comprise a series of water-tight compartments. This calls for the frequent and reliable operation of a considerable number of very large valves. It is important that control of these valves shall be as far as possible under the immediate direction of the Dock Master. This is carried out in the following manner:—

The opening and closing of the valves is effected by pneumatic rams or presses operated by compressed air at a pressure of 80 lb. per square inch. The pneumatic valves controlling the presses are electrically operated from the valve house situated on the foremost end of the starboard wall. A diagram showing a typical circuit is given in Fig. 4, which also shows a section of an electro-pneumatic valve. From these it will be seen that a press is situated above each of the sluice and flap valve rods, to which it is connected. The movement of the press is indicated in the valve house by means of a circuit breaker controlling an indicator. The electro-pneumatic valve is at the right of the press. On the magnet being energised—*i.e.*, when the valve slide or switch in the valve house is operated—the exhaust passage is closed and the inlet opened, and air passes into the press through a ¼in. pipe, thereby lifting the water valve. By suitably proportioning the inlet, the press can be made to work as slowly as desired. All the time the magnet remains energised, the water valve is lifted, but as soon as the current is cut off by the movement of the valve slide on the valve table, the water valve closes by gravity and expels the air from the press.

Attached to the stirrup is a circuit breaker, which indicates to the operator in the valve house the position of the press. This circuit breaker is so arranged that it indicates positively both the "open" and "closed" positions of the water valve to which it is connected.

Indication of the position of the valve slide is given to the operator in the pump room, a lamp being lit when the valve slide is moved to the open position.

Should the electric current fail, the electro-magnets can be operated by hand, and if the air pressure should fail, the presses can be raised by means of the hand-lifting gear, as shown in the diagram. A Westinghouse non-seizable cock is inserted in the air pipe of each press, so that the air can be cut off or throttled, as may be required. Compressed air is supplied to a main reservoir, from which one main air pipe is taken along each deck, and connected by branch pipes with the electro-pneumatic valves.

In the valve house a table is provided for carrying the valve slides which actuate the electro-pneumatic valves. On this table are also placed the indicators—electrically connected with the circuit breakers—alongside the valve slides, which constantly indicate to the operator the position of the water valves, *i.e.*, "open" or "closed." A switch is provided on the valve table for cutting off the electric current, as this would only be used during the time the water valves were held open. Secondary batteries provide the necessary electric current at 22 volts.

The complete system was provided by the Westinghouse Brake and Saxby Signal Company, and erected by Swan, Hunter.

Non-stop Records on the L.N.E.R.

We give below details of the first down and up non-stop runs of the L.N.E.R. "Flying Scotsman" services between London and Edinburgh, which were begun on Tuesday of this week, May 1st. The engines used are fitted with corridor tenders, whereby a spare driver and fireman can relieve the original crew while the train is running.

NON-STOP "FLYING SCOTSMAN"—DOWN. MAY 1ST, 1928.

Engine Number and Name.—No. 4472; name, "Flying Scotsman."

Load Behind Tender.—368¾ tons tare.

Departure and Arrival Times.—Depart, King's Cross, 10 a.m.; arrive, Waverley, 6.2 p.m.

Passing Times at Principal Stations.

Time.	Station.	Booked time.	Distance. Miles.
10.0 a.m.	King's Cross	10.0 a.m.	—
10.28 a.m.	Hatfield	10.26 a.m.	17¾
11.23 a.m.	Peterborough	11.24 a.m.	76¼
11.58 a.m.	Grantham	11.58 a.m.	105¼
12.54 p.m.	Doncaster	12.56 p.m.	156
1.36 p.m.	York	1.38 p.m.	188
2.33 p.m.	Darlington	2.34 p.m.	232
3.22 p.m.	Newcastle	3.24 p.m.	269
4.50 p.m.	Berwick	4.50 p.m.	335½
6.2 p.m.	Edinburgh	6.15 p.m.	393

Where Enginemen were Changed.—Just before reaching Tollerton.

Incidents of Note.—(1) Stock: New train including first-class and third-class restaurant cars in an articulated triplet. (2) Cautions: There were three permanent way cautions before Hitchin, and one after. They were (*a*) 2 min. Barnet Tunnel; (*b*) 2 min. Greenwood; (*c*) 3 min. Tullington; (*d*) 3 min. Lucker. Therefore the net time gained was 23 min. (3) Up non-stop train from Edinburgh to King's Cross was passed just south of Pilmoor. (4) Weather: Fine and clear from King's Cross to Grantham, wet and misty from Grantham to Selby, fine from Selby to Darlington, intermittent sunshine from Darlington to Edinburgh. (5) Train crew: Driver A. Pibworth and Fireman W. Goddard, King's Cross; Driver T. Blades and Fireman W. Morris, Gateshead.

NON-STOP "FLYING SCOTSMAN"—UP. MAY 1ST, 1928.

Engine Number and Name.—No. 2580; name, "Shotover."

Load Behind Tender.—323 tons.

Departure and Arrival Times.—Depart, Waverley, 10 a.m.; arrive, King's Cross, 6.14 p.m.

Passing Times at Principal Stations.

Time.	Station.	Booked time.	Distance. Miles.
10.0 a.m.	Waverley	10.0 a.m.	—
11.13 a.m.	Berwick	—	57½
12.39 p.m.	Newcastle	—	124
12.58½ p.m.	Durham	—	139
1.27½ p.m.	Darlington	—	161
2.17 p.m.	York	—	205
2.59 p.m.	Doncaster	—	237
4.5 p.m.	Grantham	—	287¾
4.41 p.m.	Peterborough	—	316¾
5.38 p.m.	Hitchin	—	361
6.14 p.m.	King's Cross	6.15 p.m.	393

Where Enginemen were Changed.—At Tollerton.

Train Crew.—Driver Henderson and Fireman Mackenzie, Edinburgh; Driver Day and Fireman Gray, King's Cross.

Incidents of Note.—Engine steamed well.

ELECTRIC HAULAGE FOR RHONE-RHINE CANAL.

A report from Paris states that among important projects now being discussed in Alsace is one for the improvement of navigation conditions on the canal between the Rhone and the Rhine, especially between Strasburg and Mulhouse. The Chambers of Commerce of Strasburg, Colmar and Mulhouse at recent meetings, have agreed to devote large sums in their budgets to the eventual execution of these works. Moreover, the development of navigation in the direction of Switzerland during the last few months has rendered improvements urgent. At present twenty or thirty barges go daily through the Markolsheim locks, most of them coming from the Sarre and proceeding to Colmar, Mulhouse and Switzerland. A marked increase in the annual traffic on the Rhone–Rhine Canal may thus be expected.

Another argument in favour of the improvements is that work on the great Alsatian Canal, begun in the Kembs section, will probably only proceed very slowly. It is urged, therefore, that river traffic should meanwhile have at its disposal a means that would enable it to flourish under normal conditions.

In view of these facts Monsieur Haelling, director of the Port of Strasburg, has drawn up a project for the organisation of electrical haulage by tractors on rails for the Rhone–Rhine Canal in its Alsatian part. He proposes the use of tractors on rails with trolleys, the gauge being 1 m. or 0·60 m. The metre gauge is used in the North of France, but the narrower gauge would be less expensive to lay, and would have the advantage of being easier to carry over difficult points, such as bridges, locks, &c. No experiments in electric haulage on a 0·60 m. gauge seem, however, yet to have been made.

In conformity with the desires expressed by the Mulhouse Chamber of Commerce experiments are now being made to find out whether tractors with accumulators or trolleys should be used, and it seems likely that before long Alsace will possess modern methods of transport by water well adapted to its needs.

SIXTY YEARS AGO.

The degree to which our rivers and streams were being polluted by sewage and the waste products of manufactories was a source of concern to some thoughtful people sixty years ago. Progress in the right direction was, however, hampered by indifference on the part of the Government and on that of many of the inhabitants most intimately affected by the prevalence of pollution. It was also hampered by the existence of vested interests. From a leading article in our issue of May 1st, 1868, we gather that two recent cases heard in the Courts had established the existence in certain quarters of "prescriptive rights to befoul a river." Something towards effecting an improvement in the state of the Thames had been done by the steps taken in the direction of providing London with a main drainage system. We regarded these steps, however, only as constituting a half measure. The system got rid of the sewage so far as the Metropolis was concerned, but it merely effected a transference of the evil with respect to the river. At Belvedere and Erith deposits of black mud were being formed, a fact which, we said, provided incontestable evidence that the reflux of the tide could not be relied upon to carry the sewage out to sea. Recent parliamentary action had prohibited the discharge of sewage into inland rivers and streams not subject to tidal influence. We maintained that such discharge ought to be prohibited in all cases, if only on the ground that the sewage, properly treated, was far too valuable as a manure to waste. The Act, we continued, prohibited the discharge of sewage into rivers and streams but did nothing to restrict the discharge of waste products from gasworks, tanneries, chemical, dye and manure works, and a host of other establishments. We criticised this omission because, in our view, the prohibition of one form of contamination and not others was unfair, and because it might well be disadvantageous. Our argument was that with all sources of contamination present, a neutralising effect might occur which would be stopped by the omission of some sources and not of others. We urged that all sources of contamination should be prohibited. Manufacturers might find it difficult to dispose of their waste products otherwise than by discharging them into the nearest river, but we argued that in many of their waste products they were losing tons of valuable material, just as at one time the sources of the beautiful aniline dyes were disregarded and thrown away as rubbish.

SPANISH MOTOR CAR INDUSTRY.

In the vast programme of economic expansion which was instituted by General Primo de Rivera, special provision was made for the creation of a motor car industry in Spain, and during the past two years many proposals have been made for achieving that object. The laying out of a network of motor roads throughout the country is expected to popularise motoring, besides attracting foreign visitors, and it is intended that the home demand shall be supplied, as far as possible, by Spanish makers. These will be assisted financially by the State, which will also distribute orders. An inquiry was first made in all the Government services to ascertain the type of car that would render the most useful service It was decided to place a contract with a British firm which offered to import a certain number of cars into Spain and then to lay out works for the construction of vehicles of the same type, but apparently the negotiations failed, for the conditions now proposed imply that the industry, assisted by the State, must be purely national. The directors must be Spanish, and three-quarters of the capital must be subscribed in Spain, while the raw material must be Spanish except in cases where foreign material can be imported at 15 per cent. less cost. On the other hand, it is required that orders given out by the State shall be executed at a price that shall not be more than 10 per cent. above the international price for goods of the same quality. For cars of 12 horse-power and less 75 per cent. of the parts must be manufactured in Spain, but for the heavier vehicles the proportion may be reduced to 50 per cent. The industry will be under the complete control of a committee appointed by the State, which will centralise orders, distribute raw material and advance money to manufacturers from a special fund, supplied mainly by loans from the Government and by taxes on motor cars. The machine tools necessary for the manufacture of motor cars may be imported free of duty. It is stated that two or three new firms will soon be manufacturing motor cars and that a national motor show will be organised in the near future to mark the creation of the new industry.

Railway Matters.

ON Friday, April 27th, the 10 a.m. from Euston was divided, and the sections ran without the usual call at Carlisle and Symington, through to Edinburgh, 399¾ miles, and to Glasgow, 401¼ miles, without a stop.

THE Peking–Mukden Railway Administration is contemplating the construction of double tracks on the Tientsin–Shanhaikwan section of the line, and has obtained the approval of the Ministry of Communications. Construction work will begin as soon as a definite plan has been formulated and the necessary funds raised.

WHEN the summer time-table is brought into force on June 17th, the Southern Railway will reopen Farlington Station, which was closed as a measure of economy during the war. Farlington lies between Havant and Fratton, and is the apex of the triangle of which the Havant–Fratton and Havant–Cosham lines are the two sides and the Cosham–Fratton line the base.

THE retirement of Mr. C. H. Ellison, who, after having been in that company's service since November, 1877, was made the telegraph superintendent to the North-Eastern Railway in October, 1902, took place on April 30th. On the incorporation of the N.E.R. in the London and North-Eastern Railway, Mr. Ellison became the telegraph superintendent for the North-Eastern area of the larger system.

IN this column of our issue of April 13th mention was made of an application by the National Union of Railwaymen to the National Wages Board for the abolition of such hybrid grades as porter-signalman and porter-guards, *i.e.*, where porters occupy part of their time in other occupations. It has now been announced that the Wages Board has decided that no case has been made out for a change.

IN answer to a question wherein attention was drawn to the almost universal use of the 3ft. 6in. gauge in Africa, Mr. Amery recently said that the railway administrations of Kenya and Uganda and of Tanganyika have for some time kept in mind the possibility that eventually they may find it desirable to convert their existing metre gauge to 3ft. 6in., and they are now experimenting with various types of steel sleepers which will permit the widening of the gauge in the future at small expense.

THE London and North-Eastern Railway Company spent, last year, £507,990 on new lines, widenings and additions to existing railways. It is proposed to spend £722,700 on similar works during the current year. The sum of £25,300 has been reserved for additional workshop material, £10,100 for motor lorries for goods and parcels traffic, £73,000 for the new oil jetty at Hull, £10,000 for other docks, £4700 for hotels, and £20,500 for extension of equipment for bulk supply of electrical energy.

IT is often suggested that British railway companies should abandon first-class bookings. A reference to the companies' annual reports will show how comparatively valuable that traffic is. The average fare paid per first-class passenger varies from 110·38d. on the Great Western to 70·50d. on the London and North-Eastern. The third-class fare, excluding workmen, is from 19·53d. on the Great Western to 15·60d. on the Southern. The average fare per passenger for all classes, including workmen, is as follows:—G.W., 16·88d.; L.M.S., 15·30d.; L.N.E., 15·25d.; and Southern, 14·57d.

THE Dublin and Kingstown Railway was not only the first railway in Ireland, but was a very prosperous one. In 1856 it was leased to the Dublin, Wicklow and Wexford—later the Dublin and South-Eastern—at an annual rental of £36,000, which produced for the Kingstown shareholders about 9½ per cent. When the electric trams began to run between Dublin and Kingstown evil days fell upon the Dublin, Wicklow and Wexford, and that company, in 1903, threatened to terminate the lease, whereupon the terms were modified. An agreement has now been arrived at by the present owners of the railway and the Dublin United Tramways Company—a private concern—to pool their receipts and to divide them on the 1926 figures.

FOLLOWING the retirement of Sir William Hoy from the position of general manager to the South African Railways, changes have been made in the administration. To quote a statement made by the Minister of Railways in the South African House of Assembly: "In order to afford the general manager that personal assistance which the rapid development and expansion of our railway system demands, it is the intention to concentrate such assistance at headquarters, and to introduce a method of direct communication between all centres and the general manager's office, and so avoid the cumbersome circumlocution at present existing." The rearrangement provides for an assistant general manager (technical) and an assistant general manager (commercial), and nine system managers, each of whom will take a district, *e.g.*, Cape Town, Durban, Johannesburg.

AN interesting chapter in early railway history is about to be closed as, it may almost be said, a sequel to the establishment of Heysham as the principal port of the London, Midland and Scottish Railway. The line of the former Midland Railway between Skipton and Morecambe was built by the "North-Western Railway Company"—generally known as the Little North-Western, in order to distinguish it from the London and North-Western. In 1846 a Morecambe Harbour and Railway Company was formed which, under the same empowering Act, became vested in the "North-Western" Company. The powers included the provision of tramways, jetty and other works on the seashore at Morecambe for coasting vessels and steamers. In 1854 authority was given to build or purchase steamers to run to and from Piel and Barrow. The line itself was opened on June 1st, 1848, and, from 1852, was worked by the Midland Railway, which company subsequently acquired it. The matter is of interest at the moment because the Corporation of Morecambe and the Urban District Council of Heysham have petitioned for leave to deposit a late Bill to acquire by agreement from the London, Midland and Scottish Railway Company, "the pier, harbour, jetty, foreshore, lands, sidings and works which together form what is known as Morecambe Harbour."

Notes and Memoranda.

IT is estimated that the asbestos deposits of the Pietersburg district of South Africa contain over 3,000,000 tons of material.

THE bridge across the Kauvery, on the Mysore–Arsikere line, will have to be raised on account of the increased height of water, caused by the raising of the great Krishnarajasagara reservoir. When it was originally built, about ten years ago, it was thought that it would stand clear of the rising waters, but the change in plans will necessitate a heightening of the piers of the bridge.

THE Department of Scientific and Industrial Research has, according to the *Chemical Trade Journal*, completed a test on the Crozier retort installed by Mineral Oil Extraction, Ltd., at Wembley. The retort is of the continuously working vertical type. The coal used for the test was a Scottish splint coal, and the throughput was about 4 tons per day, although it is stated that the plant will deal with 10 tons of oil shale per day. The yields of product per ton of dry coal were 15·4 cwt. of coke, 23·9 therms of gas, 16·4 gallons of tar, 0·8 gallons of crude spirit, and 9·1 lb. of ammonium sulphate. The tar did not differ from normal low temperature tar. The temperature of carbonisation varied from about 800 deg. Cent. at the base of the retort to about 280 deg. Cent. at the top.

AN illustrated article in the *South African Mining and Engineering Journal* describes an ingenious method of lashing ore, that is to say, moving it down the stope, when the slope is insufficient to make the ore slide down. Two wire ropes are stretched between the working face and the box into which the ore is to be shot. Running on four rollers on these two tension ropes there is a steel tray, *e.g.*, a section of ground chute, open at either end, 6ft. long by 20in. wide by 6in. deep. This trough is loaded with about ¼ ton of ore, and let run down the ropes. When it arrives at the bottom it is stopped abruptly by buffers and the ore is shot out into the box. The trough is then hauled back by a light rope. Three "boys" can handle, in this way, over 30 tons of ore per shift.

ACCORDING to Paul Schafmeister and Raffaello Zoja, the carbon content of eutectoidal manganese steels decreases with rising manganese content. Thus, with 1 per cent. Mn it is 0·83 per cent. C; with 2 per cent. Mn, about 0·77 per cent. C; and with 3·1 per cent. Mn, about 0·71 per cent. C. Planimetric measurements of the ferrite areas on polished and etched surfaces of steel containing 1 to 3 per cent. Mn with the correct eutectoidal carbon content showed that the percentage of ferrite decreased with an increase in the rate of cooling and with an increase in the percentage of manganese, and that the influence of the rate of cooling on the proportion of ferrite increased with higher manganese content. For a constant rate of cooling and manganese content, the relation between the proportion of ferrite and the carbon content was not a straight line, but a curve.

IN the course of a paper read at the recent annual Convention of the American Institute of Steel Construction, Dr. R. Modjeski summed up the advantages of steel for bridge construction as compared with reinforced concrete, as follows:—(1) Steel can be thoroughly tested before it goes into the structure. It can therefore be relied upon to carry the loads assigned to it better than reinforced concrete, which requires not only tests of cement and aggregates over long periods of time, but also a constant and strict supervision during construction. (2) The stresses in steel can be calculated with much more precision than in reinforced concrete. (3) The time required for steel construction is, in most cases, shorter than for concrete. (4) Steel construction may be carried on during freezing weather with perfect safety. (5) It is absolutely permanent when kept protected from moisture.

IN the course of the discussion of a paper on "The Inner Crystal Structure of Some Native Metals," at the Institution of Mining and Metallurgy, Professor W. H. Merrett suggested that there was little doubt that meteoric iron had been used in the manufacture of a Saxon sword, which was discovered some years ago in a stone coffin in East Anglia. An analysis revealed the fact that it contained 7 per cent. of nickel, the remainder being mainly iron, while there was practically no carbon present. A microscopic examination was then made, and it was found that the metal contained no slag. Iron manufactured by any of the ancient processes invariably contained slag, but, as none was present in this case, it was fairly safe to assume that the metal was either a native or a meteoric alloy. Formerly, it was supposed that all native iron was of meteoric origin, but this view had been modified since the large masses of iron found at Disco Island, in Greenland, were associated with a basalt containing iron disseminated in small nodules, which were evidently the constituents of the basalt. Terrestrial iron had also been formed by the firing of coal measures in contact with iron ore, and the product of the action was practically a native steel.

A LECTURE given recently by Monsieur Guillet, the Director of the Ecole Centrale, to the members of the Academy of Science, has aroused much interest in Paris. The lecturer spoke of a new process of treating steel, which, he said, rendered it very much more resistant than untreated metal. This "acier nitrure," as he called it, had, he said, been tested in motor engines and aeroplanes, the cylinders being made partly of the usual metal and partly of the new steel. After 30,000 kiloms. the ordinary metal in the motor engine showed 40 per cent. of wear, and the new steel only 2 per cent. After running for 100 hours the cylinders of an aeroplane engine showed wear amounting to ·08 to ·1 per cent., whereas the "nitrurated" cylinders gave no evidence of wear at all. The consumption of oil, he said, was also less with the new steel. This is the third communication made by Monsieur Guillet to the Academy of Science concerning the "nitruration" of steel. Some time ago he discovered that the heating of certain kinds of steel to a temperature of 500 deg. Cent., in the presence of ammonia, resulted in an extraordinary hardening of the metal. The combination of ammonia and of aluminium contained in the steel formed a protective covering which was so hard that a file could make no impression on it.

Miscellanea.

A GRAIN elevator with a capacity of 1,000,000 bushels is to be erected at Toronto.

IT is proposed to build a bridge across the Liao-ho at Newchang Station on the Peking–Mukden Railway.

THE Baghdad Corporation is engaged in considering the proposal of constructing a new city in the suburbs of Baghdad.

SOME 12 miles of 20,000-volt cable are being laid at Port Elizabeth, South Africa, by the British Insulated Cable Company.

THE equipment of 500 looms at the Shen Sing No. 3 cotton mill at Wusih, China, has been extended by the addition of 400 more looms.

A PAPER mill at Shanghai is utilising the reeds, which grow in profusion along the river banks, as a raw material. Its capacity is about 45,000 reams a year.

THE United States Government proposes to extract helium gas from the natural gas of the oil wells at Amarillo, Texas, by means of a special plant put up there for the purpose.

THE total number of kilowatt-hours sold by the Shanghai Municipal Electricity Department during the year 1927 was 400,343,385. The capacity of the plant is 121,000 kW. The department employs 3191 Chinese.

A NEW shaft-sinking record has been established in South Africa at the Springs Mines' No. 4 vertical shaft. During March three shifts consisting of a sinker and helper and a gang of forty-two boys, working thirty-one days with Ingersoll-Rand drills, sank 286ft.

THE existing power plant of the Volkarust Council consumes 25 lb. of coal per kilowatt, so it is proposed to put in two new 150-kW engine-driven alternators, and supply on the four-wire, three-phase system at 220/380 volts. It is expected to bring down the coal rate to 6·5 lb. and effect a saving on £500 a year.

A FEW days ago an Imperial Airways pilot, Captain R. H. McIntosh, created a new air record by making a non-stop flight from Berlin to London, a distance of 600 miles, in 4½ hours. The machine used was that in which Captain McIntosh and Mr. Bert Hinkler made their unsuccessful attempt to fly non-stop to India last year.

ON and from May 7th the Manchester branch offices of the Designs and Trade Marks Registries, which at present occupy separate premises, will both be accommodated at the following new address:—51, Regent House, Cannon-street, Manchester, to which all communications intended for either office should, as from that date, be addressed.

IT is understood that as the result of the New South Wales Government agreeing to supply the Federal Territory with electricity from the generating plant at the Burrinjuck dam, the Commonwealth Government will advance the State about £200,000 over a period of two or three years, in order to facilitate extension of the plant.

A CONFIDENT outlook for the future of the tin-mining industry of the county marked the annual meeting at Camborne on April 14th of the Cornish Institute of Engineers, but one member suggested that to restore the industry to a flourishing condition it would be necessary for the price of tin to be maintained in the region of £300 per ton.

ACCORDING to the United States Bureau of Mines, the United States was responsible for 72·18 per cent. of the petroleum production of the world during 1927. Russia, with 5·78 per cent., moved into second place again for the first time since 1917. Venezuela was third, with 5·14 per cent.; Mexico fourth, with 5·13 per cent.; Persia fifth, with 2·94 per cent.; and Roumania sixth, with 2·08 per cent. The world production of petroleum during 1927 is estimated to have been 1252 million barrels.

THE company which has been formed to distribute gas from the Ruhr coal basin all over Germany continues to meet with a good deal of opposition, particularly from municipalities which produce their own gas and from the railways which see in this new enterprise a probable and considerable diminution of the coal traffic. Nevertheless the company has already started operations by laying down a gas main from Dortmund to Plattenberg, a distance of 43 miles. On its completion the line will be extended to the south of Germany and then to the north to Hanover and Berlin.

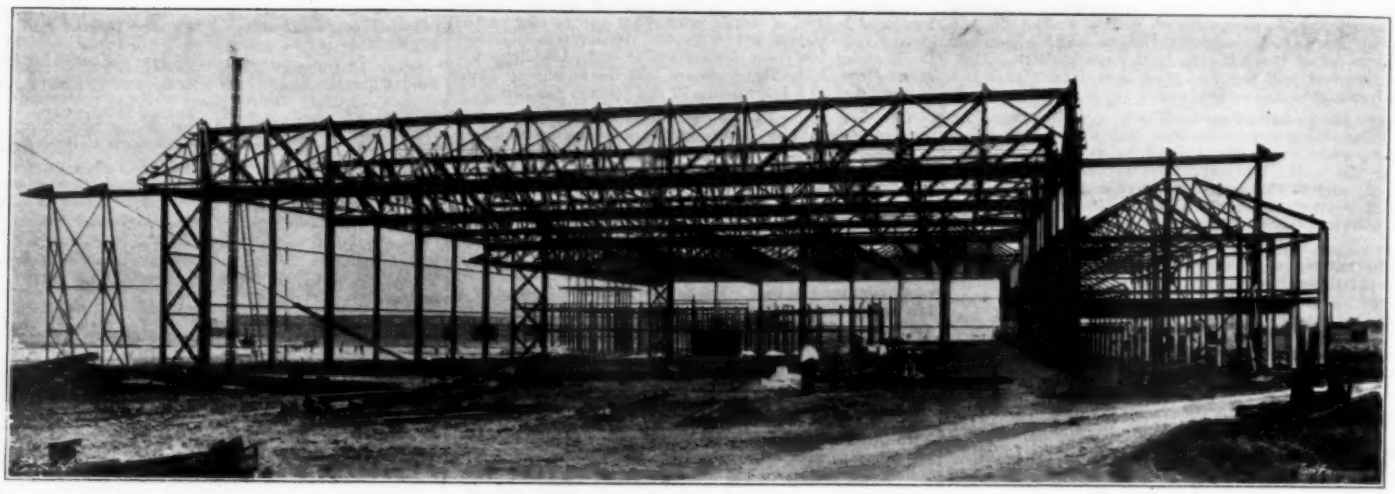
THE Electricity Supply Commission of South Africa proposes to extend its 33,000-volt transmission line to Paarl from a point near Mulder's Vlei to a sub-station at a convenient point in Stellenbosch, to which point will be connected also an extension from near Eerste River of the 33,000-volt line to the Cape Explosives Works, whence mains at 550 volts, three-phase, would be led to five transformer pillars equipped with auto-transformers supplying the reticulation system with electric energy on the 380/220 volts, three-phase, four-wire system. This will involve altering the whole of the existing direct-current 440/220 volts system to three-phase, at an estimated cost of £4500; but, on the other hand, extensive additions would in any case require to be made to the distribution system, in view of the increasing demand.

BY order of the Civil Governor of the Chinese province of Chihli, an Inspectorate General of Mines in Chihli Province has recently been set up for the protection and development of mining enterprises in the province. Chihli is rich in mineral deposits, covering an area of several hundred square miles, extending from the mountain ranges of Chang-Pai Shan in the East (Mongolia) to Tai-Hang Shan in the West (Shansi). The Inspectorate will assume the responsibility of encouraging and protecting the mining industry, and as a preliminary step a number of officials have been sent out to investigate present conditions. All mining areas that are not being worked will be taken up and considered along modern lines for operation. Existing mines will be given attention for improvement, so as to obtain full benefit of the natural resources. Transport facilities are also to be arranged for by efficient handling of rolling stock.

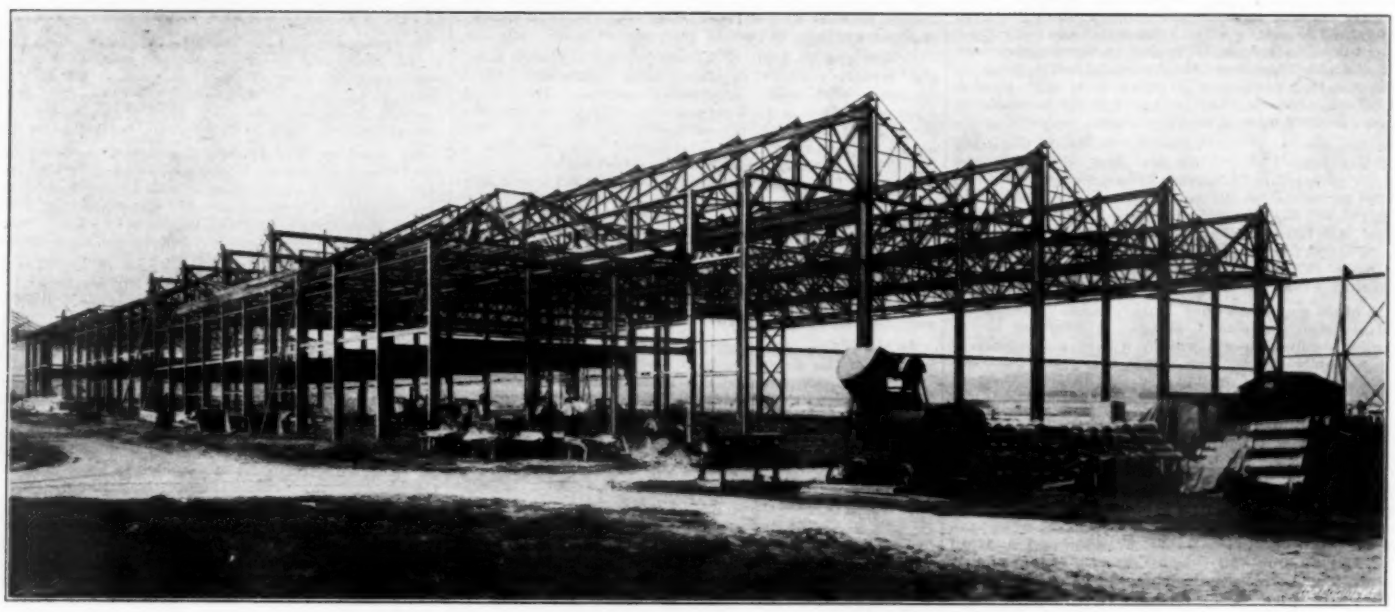
NEW AIRCRAFT SHEDS AT CROYDON AERODROME

WRIGHT, ANDERSON AND CO., LTD., GATESHEAD-ON-TYNE, ENGINEERS

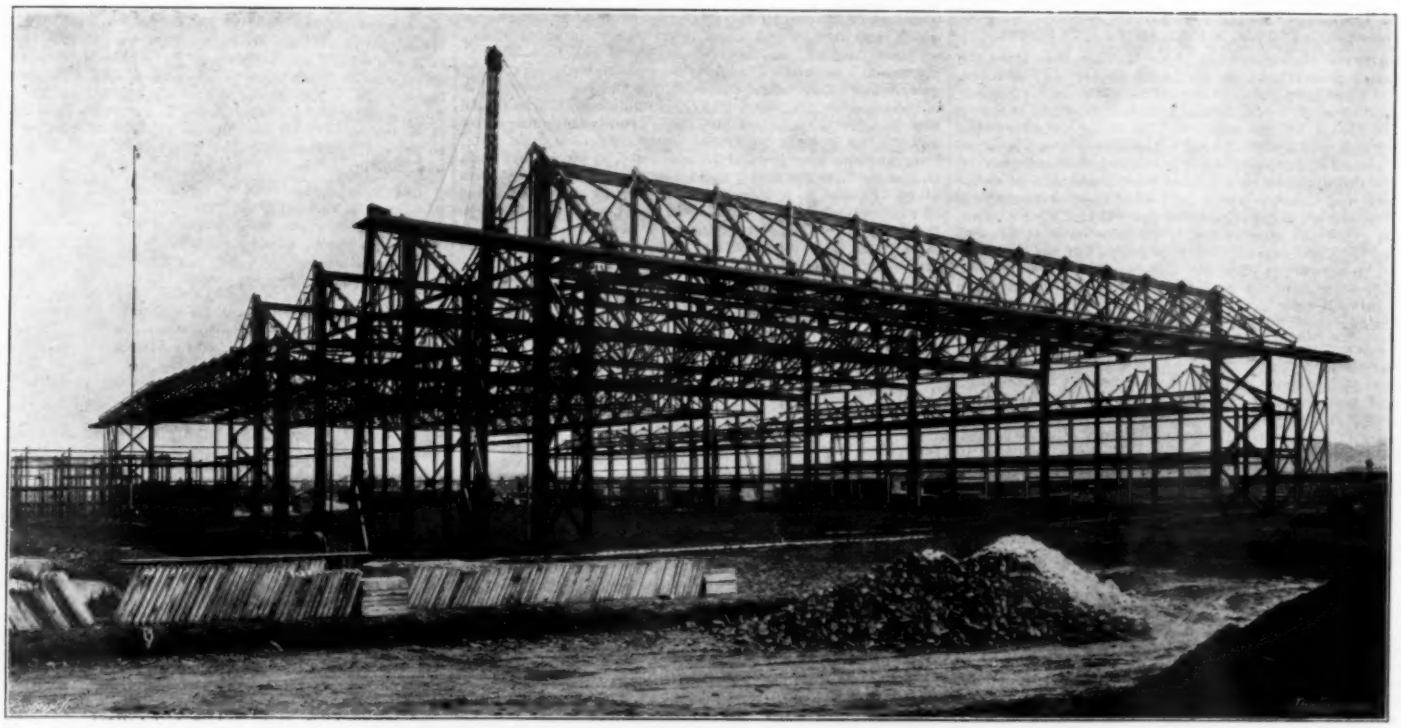
(*For description see page* 493)



FRAMEWORK OF SHED FROM SOUTH END



VIEW OF SHED FROM NORTH-EAST CORNER



VIEW OF SHED FROM SOUTH-WEST CORNER

The Engineer
Annual Subscription Rates

(including postal charges).

Subscriptions will be accepted by the Publisher direct or through a newsagent at the rates and in the currencies stated below:

BRITISH ISLES	£3	5	0	
CANADA	£3	3	0	Thick Paper edition.
	£2	18	6	Thin Paper edition.
ABROAD (except Canada)	£3	7	6	Thick Paper edition.
	£3	3	0	Thin Paper edition.

AFRICA		Central News Agency. All Branches
* £3 7s. 6d.		CAPE TOWN: Wm. Dawson and Sons, Ltd.,
† £3 3s. 0d.		29–31, Long-street (Box 489)
		JOHANNESBURG: C. Juta and Co.
ARGENTINA		BUENOS AIRES: Mitchell's Book Store, 576,
* £3 7s. 6d.		Cangallo
† £3 3s. 0d.		
AUSTRALIA		Gordon and Gotch (Australasia), Ltd. All
* £3 7s. 6d.		Branches
† £3 3s. 0d.		MELBOURNE: Robertson and Mullens, Elizabeth-street
BELGIUM		BRUXELLES: W. H. Smith and Son, 78–80,
* Fr. 590		Rue du Marché-aux-Herbes
† Fr. 550		
CANADA		American News Company, Ltd. All Branches
* $15·25		MONTREAL: Gordon and Gotch, Ltd., 334,
† $14·25		Notre Dame-street, W.
		TORONTO: Wm. Dawson and Sons, Ltd., 87, Queen-street East
		TORONTO: Gordon and Gotch, Ltd., 45, Richmond-street, E.
CEYLON		COLOMBO: Wijayartna and Co.
* Rs. 44·5		
† Rs. 41·5		
CHINA		HONG KONG: Kelly and Walsh, Ltd.
* $37		SHANGHAI: Kelly and Walsh, Ltd.
† $34·5		
EGYPT		CAIRO: Express Book and Stationery Store,
* £3 7s. 6d. (Pt. 330)		9, Chareh Maghrabi
† £3 3s. 0d. (Pt. 308)		
FINLAND		HELSINGFORS: Akademiska Bokhandeln,
* M. 650		Alexandersgatan, 7
† M. 605		
FRANCE		PARIS: Boyveau and Chevillet, Rue de la
* Fr. 418		Banque, 22
† Fr. 390		PARIS: Berger Leverault, 229, Bld. St. Germain
		PARIS: Brentano's, 37, Av. de l'Opera
		PARIS: Dunod, 92, Rue Bonaparte
GERMANY		BERLIN: H. Hermanns, Friedrichstrasse 218,
* R. mks. 70·00		S.W. 48
† R. mks. 65·00		WESTERN GERMANY: Fritz Rehfus, Blumenthalstrasse 10, Cologne
		LEIPZIG: K. W. Hiersemann, Konigstrasse 29
HOLLAND		ROTTERDAM: Hector's Boekhandel, Noordblaak 59
* Fl. 41·00		ROTTERDAM: Techn. Boekhandel, "Plan C,"
† Fl. 38·00		Gelderschestraat 4
INDIA		BOMBAY: Thacker and Co., Ltd.
* Rs. 45		CALCUTTA: Thacker, Spink and Co.
† Rs. 42		
ITALY		MILAN: Ulrico Hoepli
* Lire 300		ROME: Maglioni and Strini, 307, Corso
† Lire 280		ROME: Fratelli Treves, Corso Umberto 1, 174
		ROME: Fratelli Bocca
JAPAN		Maruzen Co., all Branches
* £3 7s. 6d.		
† £3 3s. 0d.		
JAMAICA		KINGSTON: Educational Supply Co.
* £3 7s. 6d.		
† £3 3s. 0d.		
NEW ZEALAND		AUCKLAND: Whitcombe and Tombs, Ltd.
* £3 7s. 6d.		Gordon and Gotch, Ltd. All Branches
† £3 3s. 0d.		NAPIER: J. Wilson Craig and Co.
RUSSIA		LENINGRAD: Mezhdunarodnaya Kniga, Prospect Volodarsky, 53 A
* £3 7s. 6d.		MOSCOW: "Litisdat," Kousnetsky Most, 5–15
† £3 3s. 0d.		
STRAITS SETTLEMENTS		SINGAPORE: Kelly and Walsh, Ltd.
* $29·25		
† $27·25		
SWEDEN		STOCKHOLM: A/B Wennergrens Journal.
* Kr. 61·00		expedition, Stockholm 1
† Kr. 57·00		STOCKHOLM: A/B C. E. Fritzes Kungl., Hofbokhandel, Fredsgatan, 2
SWITZERLAND		BERNE: Joh. William De Groot, Laupenstr. 5
* Fr. 85·20		ZURICH: Rosa Leibowicz, 4, Ankerstr.
† Fr. 79·50		
UNITED STATES OF AMERICA		International News Co. All Branches
* $16·40		
† $15·25		

* *Thick Paper.* † *Thin Paper.*

These rates are liable to alteration if exchange fluctuations require it.

*** READING CASES, *to hold two copies of* THE ENGINEER, *cloth sides and leather backs, can now be supplied at 4s. 9d. each, 5s. 3d. post free.*

"THE METALLURGIST."

This Supplement, which deals with the Science of Metallurgy, both ferrous and non-ferrous, is published free with the last issue of THE ENGINEER in each calendar month.

ADVERTISEMENTS.

The charge for Classified Advertisements is 1/- per line up to one inch—minimum charge 4/-; those occupying one inch or more at the rate of 12/- per inch. Orders must be accompanied by a remittance. The rates for Displayed Advertisements will be forwarded on application. Classified Advertisements cannot be inserted unless delivered before TWO o'clock on Thursday afternoon (the day before publication).

Letters relating to the Advertisement and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters are to be addressed to the Editor of THE ENGINEER.

THE ENGINEER DIRECTORY.

This Directory, which is published annually in the interests of advertisers in THE ENGINEER, may be obtained free of charge on application to the Publisher.

Postal Address, 33, Norfolk-street, Strand, W.C. 2.
Teleg. Address, "Engineer Newspaper, Estrand, London."
Telephone Nos. Central 2256, 2257.

By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

Contents.

THE ENGINEER, May 4th, 1928. PAGE

A SEVEN-DAY JOURNAL .. 477
AN AMERICAN EXPERIMENTAL ARCH DAM. (Illus.) .. 478
GENERAL DEVELOPMENT OF THE LOCOMOTIVE. No. IV. .. 481
THE BASIC OPEN-HEARTH PROCESS. (Illus.) .. 482
NEW DESIGN OF TIN-SMELTING FURNACE .. 483
THE KITSON-STILL LOCOMOTIVE. (Illus.) .. 484
LETTERS TO THE EDITOR—
Automatic Sub-stations .. 485
ELECTRICAL EQUIPMENT OF THE SINGAPORE FLOATING DOCK. (Illus.) .. 486
NON-STOP RECORDS ON THE L.N.E.R. .. 488
ELECTRIC HAULAGE ON THE RHONE-RHINE CANAL .. 488
SIXTY YEARS AGO .. 488
SPANISH MOTOR CAR INDUSTRY .. 488
RAILWAY MATTERS .. 489
NOTES AND MEMORANDA .. 489
MISCELLANEA .. 489
LEADING ARTICLES—
The Internal Combustion Locomotive .. 491
Overhead Power Lines .. 492
LITERATURE .. 492
THE LONDON TERMINAL AERODROME, CROYDON. (Illus.) .. 493
A NEW VERTICAL MILLING MACHINE. (Illus.) .. 494
THIRD REPORT OF THE WIRE ROPES RESEARCH COMMITTEE. (Illus.) .. 495
HIGH-POWERED DIESEL ENGINES FOR PEAK LOADS. (Illus.) .. 496
BOOKS OF REFERENCE .. 497
A NEW TRAFFIC SIGNAL. (Illus.) .. 498
THE BURDEN OF LOCAL TAXATION .. 498
PROVINCIAL LETTERS—
The Midlands and Staffordshire .. 499
Lancashire .. 499
Sheffield .. 500
North of England .. 500
Scotland .. 501
Wales and Adjoining Counties .. 501
BRITISH WATERWORKS ASSOCIATION .. 501
CURRENT PRICES FOR METALS AND FUELS .. 502
FRENCH ENGINEERING NOTES .. 503
BRITISH PATENT SPECIFICATIONS. (Illus.) .. 503
FORTHCOMING ENGAGEMENTS .. 504
PERSONAL AND BUSINESS ANNOUNCEMENTS .. 504
CONTRACTS .. 504

NOTICES TO READERS.

*** *If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *No undertaking can be given to return drawings or manuscripts: correspondents are therefore requested to keep copies.*

THE ENGINEER.

MAY 4, 1928.

The Internal Combustion Locomotive.

ON Sunday last we had the pleasure, as recorded on another page, of attending a full-scale trial of the Kitson-Still locomotive. The runs were carried out over what must in all fairness be regarded as a very difficult route, and to a rather exacting time-table. That is as it should be, for the intention of the railway company, with whose assistance the tests were made, was to find out if the engine could be entrusted with regular duties. What Mr. Gresley's decision, after due consideration of the report of his representatives, may be, we cannot even guess; but we may hope that he will find the figures sufficiently good to merit a thorough test of the engine under full service conditions. The first trials, in which there were fairly long steady runs, left but little to be desired. It is true that three and a half minutes were lost by the engine in a trip of about thirty-one and a half miles, but ordinary steam engines, we suspect, have been known to lose as much as that with similar trains over the same road. On the more difficult trials of the afternoon, when the train was scheduled to stop eighteen times, there was a net loss of five minutes. That is not so good, but in face of all the conditions, the newness of the engine, the profile of the road, the shortness of the intervals between stations, and the inexperience of the operators, it cannot be regarded as bad. Only once before has the engine been over the same road, and it is fair to assume that in a few more trips it would succeed in materially reducing the time lost and would probably wipe it out altogether.

The Kitson-Still engine is of exceptional interest, not only because it is a serious attempt to meet the problem of the internal combustion locomotive, but because from start to finish it is wholly British. At a time when there is so great a tendency to adopt foreign inventions, wholly or in part, it is very pleasant indeed to find an entirely novel product which in design and construction is due entirely to the skill of our own people. We are not forgetting that other builders beside Kitson and Co. have spent large sums on experimental locomotives of British origin, sometimes with, and sometimes without, the success that their enterprise deserved; but we must rejoice over every attempt which is made by the locomotive builders of this country to sustain a heritage of which we are justly proud. The application of the internal combustion engine to railway locomotion presents problems of the greatest difficulty. A locomotive must be able to exert a large torque at starting. In the steam engine that is easy to provide, but it cannot be done with an internal combustion engine of reasonable size. Furthermore, the locomotive requires a very long range of speed control. Again, the steam engine provides readily all that can be desired, but the internal combustion engine cannot be run usefully below a certain relatively high speed. Hence it is usual to interpolate between the engine and the driving axles a speed control gear of some kind, usually, nowadays, an electrical generator and motor or variable mechanical gearing. In the Kitson-Still locomotive the problem is satisfied in a totally different way. The pistons, eight in number, can be actuated by oil combustion only, by steam only, or by the two combined. For starting—that is to say, when it is necessary to develop a high torque at no speed—steam alone is used. Then when the engine has got under way and is making some forty revolutions per minute—equivalent in the present engine to approximately four miles per hour—oil is admitted, the two sources of power working together for a time. Then, unless the loads and gradient make the exertion of greater power necessary, the steam is shut off and the locomotive continues on oil alone. It seems desirable to recall these facts because they have a bearing on the trials of last Sunday. It was not the intention of the designers of the engine that she should use much steam, and frequent starts were not contemplated. The steam was relied upon to get the train under way, and to assist the oil in heavy collar work, but it is obvious that the high thermal efficiency of the oil engine cannot be secured if steam, generated in an independently oil-fired boiler, must be used as well. Hence the second series of tests with its frequent stops and starts was particularly severe on this type of locomotive, and there is no reason at all to doubt that in a service with longer non-stop runs, and, we may add, with a less proportion of very severe gradients, she would do a great deal better, and would have an opportunity of demonstrating the advantage of almost constant torque at all speeds above a minimum which the internal combustion engine gives. She was designed, as a matter of fact, to haul trains of 380 tons on an average road which is assumed to have continuous inclines of one in three hundred and twenty miles in length. On such a road she should attain a mean speed of about forty miles per hour. Given those conditions and a stop once every hundred miles or so, it is estimated by her designers that she would consume 324 lb. of oil, as against 1670 lb. of coal by an equivalent steam locomotive, and 206 gallons of feed water as against 1380 gallons. How vastly different these conditions are from those which obtained on Sunday last is obvious from an inspection of the charts and tables given on pages 484 and 485. Whereas the oil engine should have been doing over 90 per cent. of the work, it was unquestionably doing far less, so that not only was the efficiency reduced, but the boiler was overtaxed.

The enterprise which the London and North-Eastern Railway has shown—an enterprise for which, under the guidance of Mr. Gresley, it has become notable—in giving the engine a test is something of which all who take an interest in British locomotive work must be grateful. We trust, now, that the company will go still further, and put the engine into a service in which it may be possible to measure the efficiency of the Kitson-Still system. After all, the object aimed at in the employment of the internal combustion locomotive is the reduction of fuel consumption. That is the only reason, in this country, for considering any departure from the normal type, which has served the world so well for a hundred years. If the Kitson-Still cannot reduce the cost of hauling a ton a mile, it will have little or no chance of success in Great Britain. Once, therefore, it has been settled that the engine can perform such duties as it may reasonably be called upon to undertake, the next step is to find out if it is more economical than other types. We have laid some stress upon the qualification "in this country," for in some other countries wholly different conditions prevail, and fuel economy may not be so important as water economy. In those countries the internal combustion locomotive may find a larger field of usefulness than in this on that account alone, but in any country economy of fuel will always be

welcomed, and if the Kitson-Still locomotive can realise it without an equivalent increase of maintenance costs, its success should be assured.

Overhead Power Lines.

On account of considerable agitation on the part of electricity supply authorities and others, the Electricity Commissioners have recently reviewed the overhead lines regulations adopted by them in the latter part of 1923, with the object of determining whether some of the rules might be modified without detriment to the public safety. Certain alterations have now been made, but whilst the revised code should to some extent cheapen overhead distribution, it will not bring the cost down to the level that some seem to desire. Lines constructed in accordance with the latest ideas have already been erected at Chester, and the publication of the Commissioners' new code has had the effect of legalising them. For the most part, the relaxations apply to low-pressure distribution systems suitable for country parts, where the cost of cables is prohibitive on account of the low load density, and where it is essential that services should be provided at minimum cost. In view of the relaxation that has been made in the assumed ice loading, viz., a loading of three-sixteenths of an inch instead of a quarter of an inch in the case of low-pressure wires and three-eighths of an inch instead of half an inch on higher pressure conductors, and the relaxations in guarding requirements, the minimum size of the main copper conductor is now No. 8 S.W.G., or the nearest equivalent section of stranded conductor not less than that gauge. The minimum size of lines in general, other than service lines, is to be such that the actual breaking load shall not be less than 1237 lb. In special cases the Commissioners will be prepared to consent to the use of wooden poles other than red fir, provided that suitable precautions are taken in the felling, the selection, and treatment of the timber. The wind pressure and factors of safety, as prescribed by the original code in respect of supports and of line conductors have not been altered, but it is considered that the relaxed conditions with regard to the assumed ice loading on line conductors will enable less expensive supports to be adopted. These supports must withstand the specified ice loadings and wind pressures without movement in the ground, and under the revised code it will be necessary to pay more particular attention to the foundation of wooden poles which, with the exception of small poles, will require the addition of cross members or "kicking" blocks in order that the foundations may be as strong as the pole itself. For the protection of persons working on the outside of buildings, all live conductors that lie within six feet of the building must be covered with durable insulating material.

Although the construction of lines at different voltages on the same supports was not precluded under the original code, the Commissioners have considered it desirable to include a new regulation dealing with this matter. Under this regulation they will be prepared to approve of types of construction which make adequate provision for avoiding danger to linesmen working on lines and for preventing contact between the higher and lower voltage systems. The minimum height from the ground of the lower voltage line conductors has been reduced from 20ft. to 19ft. across public roads, to 17ft. along public roads and in other positions, and to 15ft. in situations inaccessible to vehicular traffic. The minimum height of service lines is now 19ft. across carriageways and 17ft. along carriageways. In the past, engineers have complained bitterly about the elaborate guarding systems they have been compelled to employ in order to prevent danger, and it is a relief to find that the Commissioners have deemed it desirable to modify the regulations governing this matter. Under the new code, provided that one of the conductors is properly earthed at the point of supply, and that the lines are arranged so that this conductor is placed below the other conductors, no other guarding on the lower voltage lines is required. If the conductors are arranged in a vertical plane with the earthed wire placed lowermost, the protection afforded is adequate, but if the conductors are not so arranged, then the earthed conductor, which must still be erected in the lowermost position, must be staggered from right to left of each succeeding support. The Post Office, which is alleged to have caused power engineers a great deal of trouble, is apparently becoming rather more consistent. With the reduction in the minimum height from the ground many lower voltage lines will be able to pass beneath other lines, such as telegraph or telephone lines, and it is gratifying to know that in such cases the requirements of the Postmaster-General for guard wires will be satisfied if a single earthed wire is run above the power wires for the length of the span. The original requirement of four feet clearance between low and medium-pressure wires and telegraph lines has been reduced to two feet, but the power line supports must be placed in such a position with respect to the Post Office wires that there will be no danger to men working on the Post Office poles, and there must be no appreciable difference in sag under the worst conditions of ice loading. These and other relaxations should tend to reduce power engineers' difficulties. But they will not, in our opinion, make a very great difference to the total cost of low-voltage lines, although some of the modifications, such as the elimination of the "V" guard, are very desirable. Supports of reduced diameter and length are now permissible, but approximately 70 per cent. of the total cost of low-pressure lines is accounted for by the cost of copper and labour. Nevertheless, in country parts where there is a fair sprinkling of houses, and where the wires can be run along the roadside, these low-pressure lines appear to be fairly satisfactory. They are cheaper than cables and service connections can very easily be made.

At Chester, where Post Office obstacles do not seem to have caused much trouble, very many houses within the vicinity of the lines have been given a supply, and the fact that the lines are still being extended seems to indicate that this form of rural electrification pays. But when it comes to running considerable distances over fields for the purpose of supplying farms, which at the outset may only call for quite a small amount of current, an entrance is made upon what Mr. W. Fennell has described as genuine rural electrification, and we have yet to learn how these consumers in remote localities can be provided with really cheap current if the lines are to be profitably worked. A high-pressure scheme, using wires, such as those advocated by Mr. F. H. Clough, will not comply with the new regulations, which seem to leave the problem of supplying cheap current to farms very much in the same position as it was originally. Needless to say, the wayleave difficulties also remain. Supply engineers in all parts of the country continue to meet with great opposition when they attempt to erect lines, and not infrequently contractors are put to no end of trouble and expense on that account. There is a very marked tendency, we understand, for supply authorities to allow contractors to begin the erection of lines before all the wayleave agreements have been signed, with the result that there is often considerable delay. An obstinate farmer not infrequently holds up an important scheme, which might have been carried through without interruption, if all arguments in this connection had been settled at the outset. When any appreciable amount of overhead work is to be carried out, it would appear to pay to employ a tactful man to deal with all wayleave matters, which can often be grappled with more satisfactorily by a specialist than by an engineer. With wayleaves, however, the new regulations are not concerned. They merely specify the manner in which lines must be constructed. The original rules governing this matter were issued by the Board of Trade, and they remained in force until late in 1923, when they were superseded by the regulations of the Electricity Commissioners, who have now found it necessary to introduce various modifications. What views the bulk of overhead lines designers hold concerning the Commissioners' code we do not know, but some, at any rate, contend that the Board of Trade regulations were drawn up on a sounder basis and gave more consistent results.

Literature.

Costs for Manufacturers. By CHARLES SMITH. London: Sir Isaac Pitman and Sons, Ltd. 1928. Pages 90. Price 5s. net.

IT is not necessary to delve very deeply into this little volume to find much to criticise; indeed, from the very commencement we find ourselves taking exception to some of the general statements that appear in it. At least as regards engineering we cannot agree that "the unscientific percentage relationship between overhead charges and labour" is customary. On the contrary, a large number of the more important concerns have adopted modern systems of cost accounting which may be depended upon to yield truer cost returns than those that would be obtained by the adoption of Mr. Smith's "new and simplified method of works costing."

While we fully endorse all that is said as to the evil of using a fixed percentage to cover all working expenses, regardless of the product, we cannot agree that the whole solution of the difficulty is to be found in basing every cost on the area covered by the unit under consideration, or, expressed in another way, the unit of expense being the working expense cost per hour per square foot. It is suggested that although cost accounting can never be an exact science, the endeavour of the cost accountant should be to make it as exact as practicable, and to this end he will adopt different bases for varying items of cost, always considering what will prove to be the most equitable distribution of the load. The cost of buildings and the charges incident thereto may conveniently be broken down and applied to a definite machine on the basis of the area occupied by that machine, but, on the other hand, the cost of the foreman who directs operations on the same machine can have very little relation to the area of the machine, the number of hours that it is at work being probably a safer criterion, while charges for depreciation must certainly take into account the capital value of the machine. We have a feeling that those charges that can equitably be fixed relative to the area of a machine, are those that are the simplest to assess. Yet on some of the more complex situations the author contents himself with saying, "This should be decided on the advice of a technical expert," which is admittedly sound, but at the same time we should like to find some indication as to the direction in which that advice would be likely to lead us.

The effect of overtime and idle time receives a good deal of attention, and should certainly always be kept before the eye of the works management, but experience tends to prove that although overtime may increase the wages bill, it also increases the productive hours, thereby decreasing "oncost," the result being that frequently costs are equated.

Mr. Smith would abolish individual time records for the operatives, substituting his composite time sheet, which he describes clearly and at considerable length. This may have distinct advantages for certain classes of manufacture, and there is no reason to doubt the savings that are claimed for it, but, on the other hand, there must be a large number of factories where it could not satisfactorily be adopted.

In dealing with the three main factors of cost, material, labour and oncost, the author adopts the unusual course of discussing the last-mentioned first, as being of primary importance, for "in many industries it represents as much as 200 per cent. or 300 per cent. to be added to the operative or direct labour," and after having described his method of distributing these charges, he proceeds to the question of wages, leaving material for subsequent consideration, while finally he briefly describes the assembling of the total cost of the order.

We are glad to observe that Mr. Smith advocates the throwing up of the actual cost of a manufacture side by side with the estimated cost, and gives a sample form to show how it may be conveniently set out, the statement being furnished to the works manager in order that he may be able to investigate any serious discrepancies. This comparison should also be passed to the estimating department, as it may prove a very helpful check, but naturally there it must be used with reserve.

The author is anxious to interest foremen and even workmen in the important subject of "costing," and if his work, which is easy to read and follow, succeeds in this aim, it will not have been written in vain.

BOOKS RECEIVED.

The Sixth Sense. By Dr. D. F. Fraser Harris. London: George Routledge and Sons, Ltd., 68, Carter-lane, E.C. 4. Price 5s. net.

Kraftstoffe, Verbrennung und Schweröl-Vergasermotoren. By A. E. Thiemann. Berlin W. 62: Lutherstrasse 14, Germany. Price 15·50 marks net.

How to Drive a Car. Tenth edition. By the Editor of *The Motor*. London: The Temple Press, Ltd., 5-15, Rosebery-avenue, E.C. 1. Price 2s. 6d. net.

Two Essays in Early Locomotive History. By Dendy Marshall. London: The Locomotive Publishing Company, Ltd., 3, Amen-corner, E.C. 4. Price 12s. 6d. net.

Indian Storage Reservoirs with Earthen Dams. Third edition. By W. L. Strange. London: George Routledge and Sons, Ltd., 68, Carter-lane, E.C. 4. Price 25s. net.

Annales des Ponts et Chaussées. (1) Partie Administrative; (2) Partie Technique. 1928. Tome I. Fasc. I. Janvier-Fevrier. Paris: A. Dumas, 6, Rue de la Chaussée-d'Antin.

Studies in Malaria as it Affects Indian Railways. By R. S. White. London: The Office of the High Commissioner for India, 42, Grosvenor-gardens, S.W. 1. Price 5s. 10d. net.

Proceedings of the South Wales Institute of Engineers. Volume XLIV., No. 2, and Index to Volume XLIII. Cardiff: The South Wales Institute of Engineers, Park-place. Price 5s. net.

An Investigation of Webb Stresses in Reinforced Concrete Beams. Part II.: Restrained Beams. By F. E. Richart and L. J. Larson. Urbana: The Engineering Experimental Station, University of Illinois, U.S.A. Price 45 cents net.

ADMINISTRATION BUILDING AND AIRCRAFT SHEDS AT CROYDON AERODROME

The London Terminal Aerodrome, Croydon.

On Wednesday of this week the reconstructed London Terminal Aerodrome at Waddon, near Croydon, was officially opened by Lady Maud Hoare, wife of the Secretary of State for Air. The main features of the reconstructed aerodrome consist of the provision of a terminal accommodation building, a hotel and two large aeroplane sheds. It is with these sheds that we propose particularly to deal, for in their design and erection there is a considerable amount of engineering interest.

The two sheds are identical in construction. Each covers an area of 300ft. by 150ft., and is arranged in two equal sections measuring 150ft. by 150ft., and having a clear height of 30ft. The two sections together form a rectangle, the longitudinal axis of which runs north and south. The south end of the rectangle is formed as a doorway with a clear width of 150ft. The northern half of the west side is also formed as a doorway having a similar clear width. This lay-out of the sheds was adopted by the Air Ministry with a view to facilitating the landing of machines under the worst conditions of the average prevailing wind throughout the year.

On page 490 and herewith we illustrate the sheds during construction and after completion. Down the east side of each shed there runs a two-storeyed annexe, subdivided on the ground floor for stores, &c., and on the second floor for staff offices, pilots' quarters, bedrooms, bathrooms, &c. In addition, the shed nearest the terminal accommodation building has at its north end a portion forming a covered car park, measuring 150ft. by 30ft. The general structure of each section of each shed may be described as consisting of four pairs of main stanchions united by four lattice girders with a clear span of 150ft. Triangular roof trusses are suspended from the main girders. The members of each row of trusses are connected together in the valleys by riveting their ends to connecting plates. The trusses are not supported from the ground, except in the case of the extreme outer trusses, which are held up by intermediate stanchions placed beneath the valley points. The half trusses suspended from the lattice girder nearest the door end carry the top rails for the sliding doors, the two extreme half trusses being supported by stanchions braced to the adjacent main stanchions. The top rails are extended beyond the extreme trusses and have their ends supported by a pair of braced stanchions. It will be gathered from the engravings that the roof girders of one section of each shed run at right angles to the roof girders of the other section. As a consequence, the clear width of 150ft. entering from the south doors does not extend through the whole length of the shed—300ft.—but is interrupted half-way by the main stanchions of the second section. The spaces between these stanchions are filled in with brick walling so that the two sections are separate and have no internal communication with each other. In addition, it may be noted that the configuration of the ground made it economical to raise the floor and roof levels of one section 4ft. above the levels of the other section. The floors are constructed of 6in. of concrete on top of a 6in. layer of hard core. The valleys of the roof are filled with "patent glazing." The gable ends are covered with sheet metal and the rest of the exterior walls are filled with concrete blocks.

Each door opening is provided with six leaves, three sliding to the right and three to the left. Corresponding to the top rails suspended from the end roof trusses a three-track rail is bedded and bolted to a solid concrete base at the ground level. The doors are steel-framed structures, plated on the outside with ¼in. steel sheets. The weight of the leaves is taken on wheels running on ball and roller bearings. One of these wheels is connected by chain gear to a winch handle. Each section of the door weighs 6 tons, but under normal conditions it can, we are informed, be pushed along the rails by one man. Under the worst conditions the leaves can be moved readily by two men at the winch.

The erection of the steel work was carried out by ordinary methods, involving the use of hand winches and derrick poles. An unusual point was the method employed for up-ending the main girders. For this purpose an ordinary steel lattice derrick was fitted with a compensating arrangement, which ensured that the loading should be applied dead on the central axis of the derrick. The main lattice girders were built on the flat on the ground, and after they had been completely riveted, four sections of the roof trussing were attached to them. These four trusses were connected to four sets of tackle, which were operated simultaneously to pull the girder into an upright position. Two of the special derricks referred to above were then employed to lift the girders into position. Each derrick was placed at one-sixth of the span from the end of the girder. Even with these precautions, it was found necessary to provide a number of wire safety guys to prevent the girders "whipping" excessively.

The steel work for the sheds was supplied and erected by Wright, Anderson and Co., Ltd., of Gateshead-on-Tyne, in conjunction with their London agent, Mr. Wm. Sharp, M.I. Mech. E., of Westminster.

The terminal accommodation, or administration, building, with the two new aircraft sheds beyond, is illustrated in the view on this page, which is reproduced from an Air Ministry official photograph of which the Crown copyright is reserved. The administration building provides accommodation for the Air Port control staff, booking offices, Customs and immigration departments, waiting rooms, freight stores, &c. It is a two-storey building with a centrally placed control tower 50ft. high. This control tower is surmounted by the wireless direction finding aerials. Its uppermost storey forms the control room. This room is 30ft. square and is provided with windows on all sides. It is divided internally by a glass screen which partitions off the traffic officer's office from the wireless office. Externally it is encircled by a balcony for a lookout man.

The traffic officer is in communication with the aircraft in flight along the routes by means of the wireless installation, with the aircraft operating companies and other aerodrome officials by telephone, with the meteorological office by a pneumatic tube, and with the Duty Office which deals with messages concerning the arrival, departure, &c., of aircraft by means of another pneumatic tube. The traffic officer controls the landing and taking-off of aircraft by means of visual signals, such as coloured metal discs, Verey lights and rockets. He has also under his control the aerodrome obstruction lights and the neon beacon. In front of him he has a map of the sectors of the routes for which he is responsible. This map is painted on thin sheet steel and on it the position of aircraft flying along the routes is indicated by means of magnetic arrows.

Two operators are stationed in the wireless office. This office provides means for the transmission of messages between the traffic officer and the pilots of aircraft in flight over the routes. In addition it contains direction-finding equipment whereby a pilot may be informed of the bearing of his aircraft relatively to the station. His actual position may be transmitted to him by means of simultaneous bearings taken on his machine from the stations at Croydon, Pulham and Lympne.

The meteorological office is situated in the tower immediately below the control room. It receives hourly and, if necessary, intermediate weather reports from stations in South-East England, France, Belgium, Holland, and Western Germany, and transmits these reports to the traffic officer above by pneumatic tube.

For night flying purposes and for assisting pilots to land safely in foggy weather the aerodrome is equipped with a system of light signals comprising landing lights sunk in the ground of the aerodrome to indicate the direction of landing as determined by the prevailing wind, a neon beacon for penetrating fog, a flood light equipment projecting a beam over an arc of 180 deg. mounted on a motor chassis, obstruction and boundary lights and pyrotechnic signals.

The wireless services provided at the aerodrome are limited at present to messages concerning the safety of the aircraft. Personal messages to and from passengers in the aircraft may, however, shortly be permitted. The communication is effected both by telegraphy and telephony and from Croydon the sectors of the routes served extend to the continental coast. The services are maintained on a wave length of 900 m. and are in operation from one hour before sunrise to one hour after sunset. There is a low-powered wireless station at Lympne which acts as a relay station when necessary. In addition to the 900 m. service whereby communication is effected between the aerodrome and machines in flight there is a service on a wave length of 1400 m. for direct communication between Croydon and the civil aviation aerodromes in France, Belgium, Holland and Germany. A third service on a wave length of 1680 m. is maintained for the collection of meteorological information from the Air Ministry and its distribution to foreign aerodromes. The direction-finding service is operated on a wave length of 900 m. The average time taken to work out and communicate the position of an aircraft is 1 to 1½ minutes, counting from the time when the request for the information is received at Croydon.

Reception for the wireless services is carried out in the administration building. All transmission is effected by remote control from a transmitting station situated on the edge of Mitcham Common about three miles from the aerodrome. It is of interest to learn that when first installed the direction finding equipment was considerably interfered with by the proximity of the steel reinforcement in the surrounding concrete structure of the tower. This source of interference has now been allowed for, and the apparatus is, we understand, working satisfactorily.

THE JUNIOR INSTITUTION OF ENGINEERS.—The annual dinner of the Junior Institution of Engineers was held on Thursday, April 26th, at the Monico Restaurant, when Sir Murdoch MacDonald took the chair, and the gathering was one of the largest organised by the Institution which we have attended. After the usual loyal toasts "The Institution" was proposed by Mr. E. S. C. Trench, the President of the Institution of Civil Engineers, who said that the "Civils," far from being jealous of other and smaller institutions, were quite sympathetic towards them. The response was made by Mr. W. M. Hurrell, the Chairman of the "Juniors," who made a breezy speech, in which he said that the members were "cheerful boys," although some of them were "old chaps." The membership list now contained 1800 names. "The Engineering Industry" was proposed by Mr. W. J. Tennant, who pleaded for the maintenance of British quality in manufacture, regardless of foreign competition, as it was on quality that our export trade had been built up. He suggested that a society somewhat after the fashion of Lloyd's might be organised in connection with the building trades. Sir Murdoch MacDonald, in his response, pointed out what vast possibilities there are for irrigation in the amelioration of living conditions in many parts of the world, and cited, as cases of such conditions, the Sudan, the Assouan Dam, and the Gezireh. "Our Guests" was proposed by Mr. S. H. Hole and was acknowledged by Brig.-General Magnus Mowatt, Secretary, Institution of Mechanical Engineers, and by Lieut.-Colonel J. T. C. Moore-Brabazon, the President-elect of the Institution, while "The Chairman" was proposed by Mr. C. E. Atkinson.

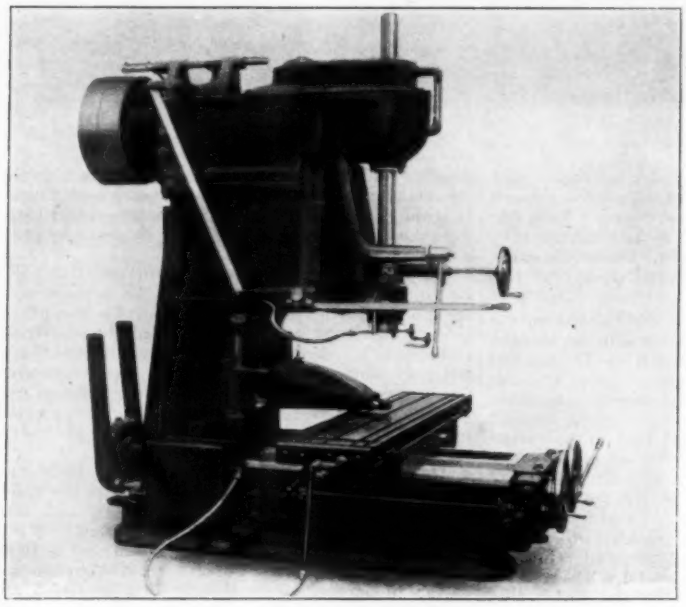
A New Vertical Milling Machine.

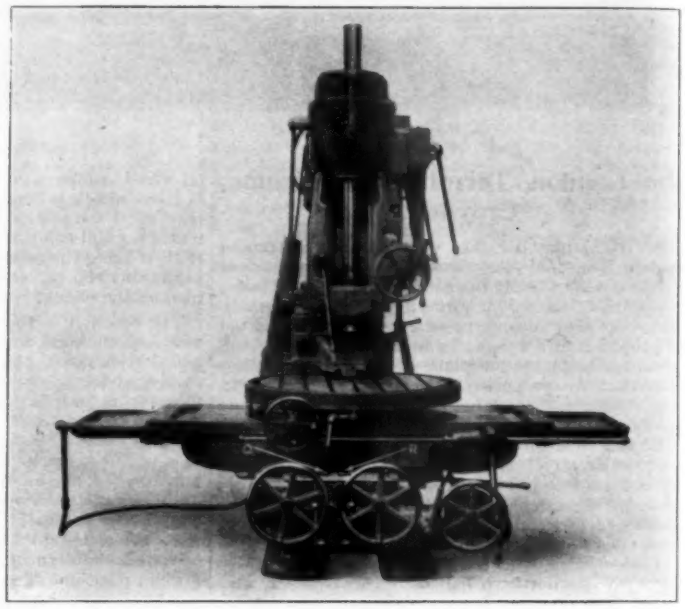
WE were recently invited to inspect a new design of vertical milling machine—known as the 28 V—which Alfred Herbert, Ltd., of Coventry, have produced in replacement of their earlier No. 8 machine of the same class. The new machine, illustrated herewith, contains several features of considerable interest, but its chief claim to attention resides perhaps less in the novelty of its details than in the convenience of its arrangement and the high commercial productive efficiency which it attains. Rigidity and long life under heavy operating conditions combined with ease of operation and adaptibility to a wide range of work, have been the guiding motives in its design, rather than the attainment of novelty in its movements or parts.

The machine, as we inspected it, is arranged for a belt drive with a fast and loose pulley overhead at the rear of the column. It can, however, be readily fitted for an individual motor drive. In the case of such a drive, the motor is bolted to a face at the foot of the column, and drives by belt on to the overhead fast and loose pulleys. by gibs along the outside edges. On top of the column the driving box is bolted. This box carries the fast and loose pulleys, the change speed gearing and the upper bearing through which the spindle slides. All the mechanism in the driving box is automatically lubricated by means of a pump inside the box. A sight feed glass at the front of the box readily permits the operator to satisfy himself that lubrication is being carried out effectively.

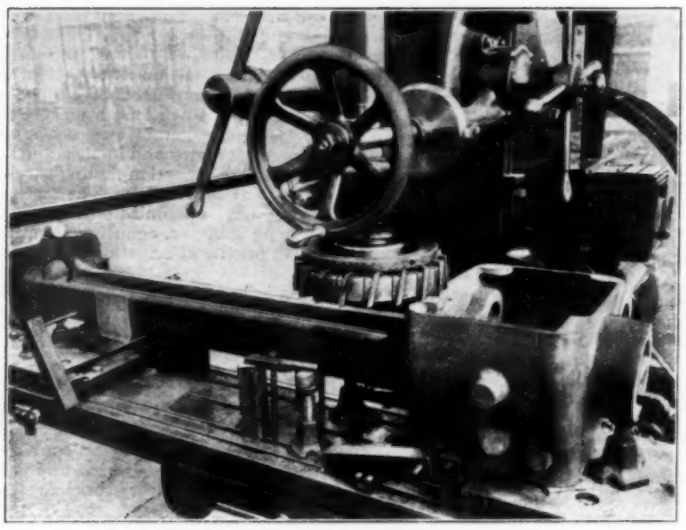
The lower end of the spindle is carried in a head sliding on vertical guides formed on the front of the column. This head is balanced by a weight inside the column, the connection being established by means of a chain. The head is adjusted for position by means of a rack and pinion through the star handle G, and can be locked to the column by a tapered gib operated by the handle H. A fine adjustment of the head is obtained by means of the hand wheel J, the spindle of which carries a graduated disc marked with a hundred divisions, each of which represents a movement of the head through 1/1000th inch. For some classes of work it is desirable to support the extreme lower end of the cutter arbor. This requirement is provided for by the fitting of a bracket K to the column. This bracket, when not in use, is swung to the rear clear of the work and table. Provision has to be made for its occupying either the handle M all the feeds can be reversed in direction. From the feed shaft running along the side of the base, the feed motion is transmitted into a gear-box bolted to the front end of the base. This box carries two hand wheels N P, of which that on the operator's left applies transverse hand feed to the saddle and that on the right longitudinal hand feed to the table. Two handles Q R—see the front view—when pulled up apply power to the feeds, and two plungers S T when depressed disengage the power drive. The transverse feed can be applied to the saddle over a range of 38in. The longitudinal feed to the table covers a movement of 62in. Adjustable safety and dead stops are provided for both feed motions. It is a particular feature of the machine that the automatic transverse and longitudinal feeds can be in use simultaneously. When the longitudinal feed only is required, the saddle can be locked to the bed by the handle U.

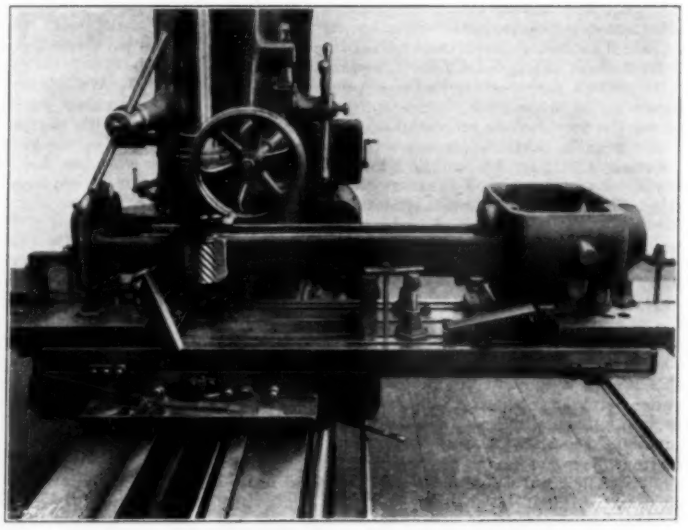
The machine can be supplied with various additional fittings. One such fitting is shown in the front view, namely, a circular table graduated round its edge and fitted with an automatic stop. Automatic rotary feed is applied to this extra table by means of spline shafts and bevel gearing deriving motion from the main feed shaft. In place of the circular table a table 36in. square and 4in.





SIDE AND FRONT VIEWS OF HERBERT HEAVY DUTY VERTICAL MILLING MACHINE





MACHINE AT WORK FITTED WITH FACE MILLING AND SIDE MILLING CUTTERS

For medium work the machine is rated at 20 horse-power. In order to secure centralised control, the belt-shifting gear is arranged to be operated by a handle A brought out to the front of the machine within easy reach of the attendant's hand. The handle B on the side of the column moves in unison with A and is used to trip the motion of the spindle when the spindle change speed gearing is being operated. That gearing is controlled by the three closely adjacent levers C D E and the hand wheel F. Each of the levers has two positions, while the hand wheel is used to set a train of sliding wheels in either of two positions. Sixteen spindle speeds are therefore obtainable. These speeds range from 12 to 360 revolutions per minute. An interlocking arrangement is provided, whereby the engagement of conflicting gear wheels is prevented.

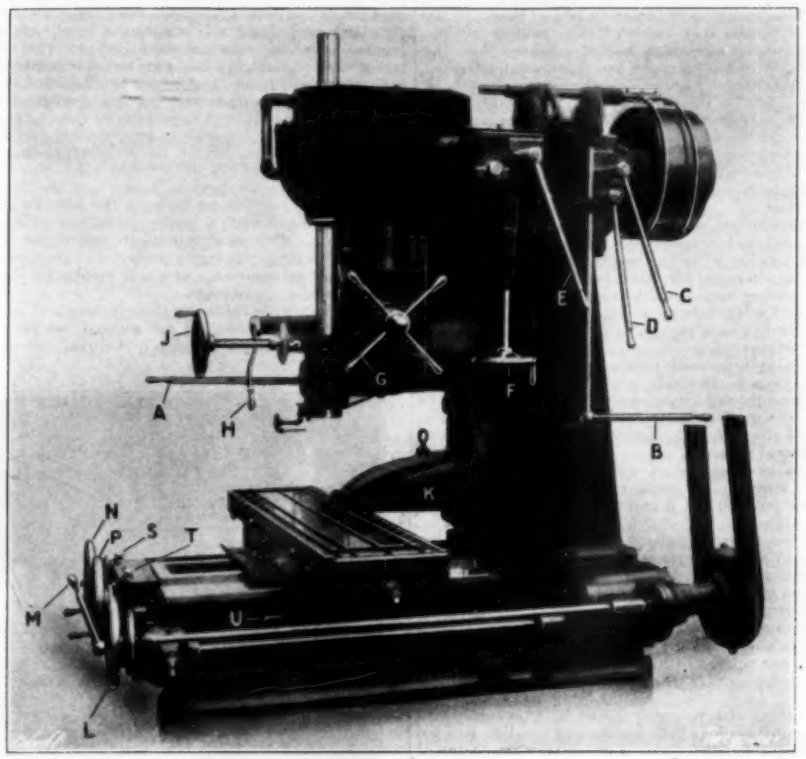
As great rigidity is a feature aimed at in the design, the construction of the general framework of the machine is worthy of note. The column is a box casting, and is formed without openings in the front, back or sides. To the front face of the column at the foot, the base carrying the saddle and work table is bolted, tenoned and keyed. It is formed with a raised tenon at the centre for the guidance of the saddle. The saddle is held down to the base of two positions vertically, a low position to suit the level of the main table and a high position to suit the level of a circular table which may be fitted on top of the main table. The positions are fixed by two races on the hinge pin—see the rear side view—and a horizontal plunger carried by the bracket and engaging with one or other of the races. The bracket is of considerable weight and is not easy to raise or lower without assistance. That assistance is provided in a neat and simple manner. An eye-bolt is fixed in the top of the bracket, and as the bracket is swung on its hinge pin, this eye-bolt passes close to a point on the spindle head, where a horizontal bolt is situated. This bolt can be shot into the eye-bolt and with the engagement made it is an easy matter to raise or lower the bracket—together with the spindle head—by means of the star handle G.

The saddle and table feeds are derived by belt from a small pulley on the end of the overhead driving shaft. The feed box is attached at the foot of the column, and is of the makers' well-known patented "dial" type. This box provides sixteen rates of feed ranging from 1¼in. to 26¾in. per minute. The feed changes are obtained simply by turning the hand wheel L, the feed selected being indicated by a dial lying just behind the hand wheel. By means of high can be bolted to the main table. This square table can be indexed into four positions and is used for milling bulky work that cannot be covered by the standard traverses of the machine. Another fitting is a radius milling attachment for milling the reversing quadrants of locomotives and marine engines. Two sizes of this attachment are available, one for milling radii up to 6ft. and the other for radii up to 13ft. The attachment takes the form of a girder extension to the base of the machine, carrying a pedestal which provides a pivot for the radius arm of a table resting on top of the main table. Other attachments are a profiling fitment operated by a weight which draws the saddle against a roller, and a die sinking attachment whereby repetition work may be executed by means of a copying arrangement.

We reproduce herewith two views showing the machine at work. In one it is illustrated equipped with an inserted tooth face milling cutter 16in. in diameter machining the top face of the gear-box in the body of a Herbert 44in. broaching machine. In this instance the transverse and longitudinal automatic feeds are applied simultaneously. In another view we show the machine engaged milling a vertical face on the same casting by means of a Coventry high-power side mill. This type of cutter with 10 deg.

HEAVY DUTY VERTICAL MILLING MACHINE

ALFRED HERBERT LTD., COVENTRY, ENGINEERS



undercut uninterrupted teeth formed at a spiral angle of 35 deg. is claimed to give exceptionally good service, particularly on heavy duties. We are informed that these cutters are equally suitable for roughing or finishing cuts and that they have removed as much as 32 cubic inches per minute from a 35-ton tensile steel block 8in. wide.

On the occasion of our visit the machine we inspected was not bolted down to the shop floor and was driven by belt from an overhead shaft. That shaft in turn was driven by a motor through a belt which was defective in its grip and which slipped badly under heavy loads. In spite of these disadvantages the machine clearly demonstrated its remarkable capacity. It was equipped with an inserted tooth face milling cutter 9in. in diameter and was set to work on a cast iron block 8in. wide. The spindle speed was set to 30 r.p.m. and the depth of cut to $\frac{1}{4}$in. Longitudinal automatic feed was applied to the table. Beginning with a feed of 6in. per minute, the operator increased the rate until it reached 26$\frac{1}{2}$in. a minute, the fastest obtainable. At that rate the belt of the motor drive slipped badly, but the machine worked without distress and produced a surface free from any sign of chatter. Had there been no belt slip at the motor the setting of the machine would have corresponded to the removal of metal at the rate of 67 cubic inches per minute.

Third Report of the Wire Ropes Research Committee.*

By Dr. W. A. SCOBLE.

THE First Report of the Committee presented in 1920 reviewed the literature relating to wire ropes, with special reference to that bearing upon the bending of wire ropes over pulleys, sheaves, drums and the like, and the first tests made were recorded in the Second Report presented in 1924. In the Third Report now presented the main results relate to repeated bending tests similar to those previously made, but employing ropes having a higher tensile strength. The same testing machine was used. It consists of a driving shaft belt driven from a motor and having a crank at one end of the shaft which oscillates the rocking shaft through a connecting-rod and rocking lever. The driving pulleys are of greater diameter than those of the test pulley. The rope under test is fastened by clips

TABLE I.

Rope No.	Construction.	Lay.	Strand construction.	Steel.
10	6×19×0·021in.	Ordinary	12/6/1	Swedish acid
11	6×12×0·021in.	Lang's	12 wires on fibre	Acid quality
12	Do.	Ordinary	Do.	Do.
13	6×19×0·021in.	Lang's	12/6/1	Do.
14	Do.	Ordinary	Do.	Do.
15	6×7×0·036in.	Lang's	6 on soft core wire 0·038 inch diam.	Do.
16	Do.	Ordinary	Do.	Do.
17	6×7×0·034in.	Lang's	6/1	

to a driving rope which causes it to move to and fro over the test pulley. The latter rotates freely on a pin in a fixed tension fitting. A calibrated spring and adjusting screw is provided, which enables any desired tension to be put on the rope, the amount of such tension being indicated by the compression of the spring. Following a short description of the machine, a general outline of the experimental scheme is given.

The New Tests of Ropes by Repeated Bending.—Particulars of the main batch of specimens tested, all of which, except Nos. 10 and 17, were supplied by the same maker, are given in Table I. All the ropes had a circumference of 1in. and were made with a tenacity of 100 to 110 tons per square inch. The pulleys were grooved to fit the rope and the flanges were flared and made tangential to the bottom portion of the groove, the section of which was the arc of a circle. Specimens were soaked in heavy cylinder oil before they were put into the machine and were lubricated during the test. For the present series of tests half a million bends was taken as the maximum number at the failure of a rope. In the paper the tests results are given in tabular form and curves plotted for the tension in the rope in pounds against the number of bends to cause

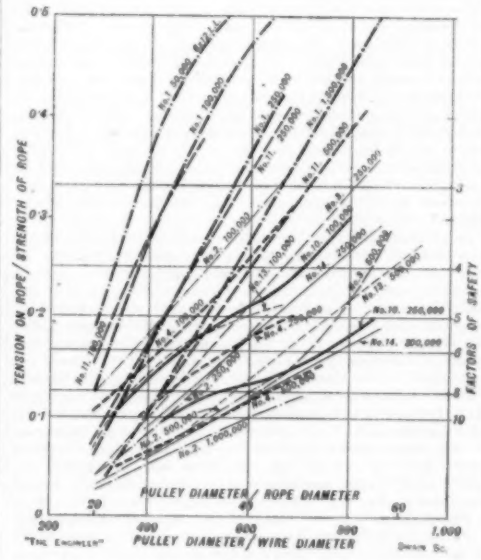

TENSION ON ROPE / STRENGTH OF ROPE
FACTORS OF SAFETY
PULLEY DIAMETER / ROPE DIAMETER
PULLEY DIAMETER / WIRE DIAMETER
"THE ENGINEER"

FIG. 1

failure, also the maximum calculated stress in the rope against the bends at failure.

The tensile stress is taken as the tension divided by the total sectional area of the wire, and to this is added the bending stress calculated from $E\,d/D$, where E is the modulus of elasticity of the steel and D and d the diameter of the pulley and the rope respectively. The pulleys varied in diameter from 6in. to 18in.

Comparison of Ropes of Both Tensile Strengths.—In order to enable a more detailed comparison to be made between the present batch of ropes and those of different tensile strengths Table II.—given in the next column—has been prepared.

All the ropes were of 1in. circumference, but the sectional area of the total wire differed appreciably. The best rope of 0·021in. wire of 80 to 90 tons per square inch was the 6 × 12 with fibre core to the strands. In all cases the fibre core to the strands showed no advantage with ordinary lay. Lang's lay was best for a 6 × 19 rope on a

TABLE II.—*Comparison of the Tensions Taken by Ropes of 80 to 90 and 100 to 110 Tons per Square Inch Tensile Strength to Cause Failure After 250,000 and 500,000 Bends.*

Construction of rope.	Pulley diam., in.	Tensions for 250,000 bends to failure, lb.		Tensions for 500,000 bends to failure, lb.	
		80 to 90 tons per sq. in., lb.	100 to 110 tons per sq. in., lb.	80 to 90 tons per sq. in., lb.	100 to 110 tons per sq. in., lb.
6×12 LL, fibre core to strand	18	—	3400	—	2430
6×12 OL, fibre core to strand	18	—	1280	—	1090
6×19 LL	18	—	2570	—	1990
6×19 OL	18	—	1630	—	1280
			2420	—	1520
6×12 LL, fibre core to strand	14	1900	2100	1500	1570
6×12 OL, fibre core to strand	14	960	930	620	780
6×19 LL	14	—	1180	870	1090
6×19 OL	14	1350	1730	890	1200
			1110	890	850
6×12 LL, fibre core to strand	10	1030	1420	640	1230
6×12 OL, fibre core to strand	10	450	675	360	630
6×19 LL	10	900	980	650	900
6×19 OL	10	870	920	550	650
			860	550	720
6×12 LL, fibre core to strand	6	260	350	—	270
6×12 OL, fibre core to strand	6	200	210	160	—
6×19 LL	6	270	280	210	—
6×19 OL	6	320	340	260	—
			330	260	280
6×6 LL	17·5	2400	—	1750	—
6×6 LL	18	—	3040	—	2600
6×7×0·036in. LL	17·5	2800	—	2460	—
6×7×0·034in. LL	18	—	2740	—	1500
6×7×0·036in. OL	17·5	1670	—	—	—
6×6×0·036in. OL	18	—	2110	—	1920
6×6×0·036in. LL	14	1280	1480	950	780
6×7×0·036in. LL	13·5	1040	—	830	—
6×7×0·034in. LL	14	—	1040	—	860
6×7×0·036in. OL	14·65	1160	—	920	—
6×6×0·036in. OL	14	—	1220	—	980
6×6×0·036in. LL	10	410	—	280	—
6×7×0·036in. LL	10	550	—	340	—
6×7×0·034in. LL	10	—	580	—	420
6×7×0·036in. OL	10	500	—	365	—
6×6×0·034in. OL	10	—	500	—	—

pulley of 860 wire diameter. In all cases the ropes of higher tensile strength carried a greater load than those of lower tensile strength in the corresponding test. The results for the cables with seven wires per strand were not so consistent and were probably affected by the variation found in the ropes made to the same specification.

Results Presented According to Current Practice.—In Figs. 1 and 2 the results are presented in a manner which, it is hoped, will be found convenient in practice. In these diagrams the pulley diameter expressed as a multiple of that of the wire or rope diameter is plotted against the tension—taken as a decimal fraction of the ultimate

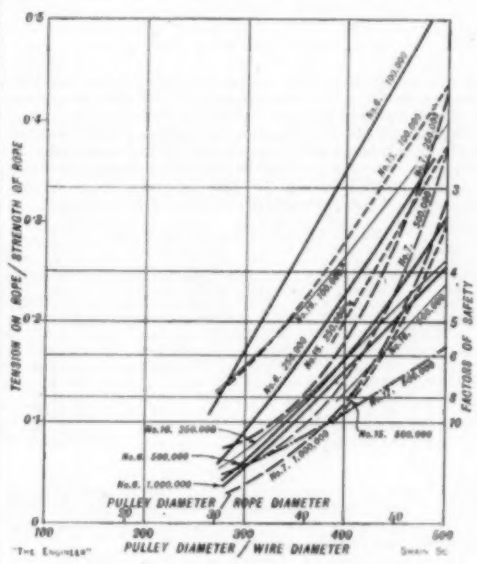

TENSION ON ROPE / STRENGTH OF ROPE
FACTORS OF SAFETY
PULLEY DIAMETER / ROPE DIAMETER
PULLEY DIAMETER / WIRE DIAMETER
"THE ENGINEER"

FIG. 2

strength of the rope which causes failure after a specified number of bends. Fig. 1 relates to the 0·021in. wire cables and Fig. 2 to the seven wire strand ropes of 0·036in. wire.

Reversed Bending of Ropes.—Some tests of complete ropes were made on the Vaughan-Epton machine used in the previous tests, and the performances of the ropes under simple and reversed bending are compared in Table III.

Trulay Ropes.—Two ropes of Trulay construction were presented by Mr. Brunton. The special feature of the process of manufacture for these ropes is that the wires and strands are pre-formed before they are laid up, with the result that there is no tendency to unlay when the rope is cut. The test data for Trulay ropes show that on

* Institution of Mechanical Engineers. Summary.

pulleys of corresponding diameter they are distinctly superior to 6 × 19 ordinary lay ropes, particularly under the severe conditions imposed by the use of small pulleys. For 6 × 7 ropes the difference was also very marked, the continuance of the Trulay ropes being in the same order as that of the normal rope on the next larger pulley.

TABLE III.—*Comparison of Performances Under Simple and Reversed Bending.*

Rope No.	Tension, single 14in. pulley for ¼ million bends, lb.	Tension, 14½in. pulleys, reversed bends, for ¼ million bends, lb.	Number of reversed bends at tension giving ¼ million simple bends.
10	1110	1120	—
12	930	660	130,000
13	1180	865	170,000
14	1730	1310	120,000

Reduction of Diameter of Ropes by Tension and Crushing.—An attempt was made to obtain some exact data relating to the crushing of ropes by putting them under lateral compression whilst under tension. The opportunity was taken to record also the reduction in diameter of a rope as the tension on it was increased. A sample of rope was put under increasing tension to about one-eighth of its ultimate strength and the new diameter was measured at intervals. A pair of flat clamps was then fitted on the rope and bore against 1½in. of its length. Measured pressures were applied to the clamps and the reductions in diameter were again recorded. The experiment was usually repeated by increasing the tension to a quarter of the breaking strength of the rope, at which point another crushing test was made. Graphs were made, enabling the results to be compared. The rate of contraction under lateral pressure was much the same for all the ropes tested.

EXPERIMENTS WITH SINGLE WIRES.

The last part of the report is devoted to a description of tests made with single wires and includes an investigation into the effect of lateral pressure on tensile strength. It is shown that the tensile strength of the wires is reduced as the lateral pressure is increased, more rapidly at first, but slowly at high compression.

Single wires were also tested on the Vaughan-Epton machine, special arrangements being made whereby a known torque could be applied to the wire instead of a definite number of twists.

Fatigue tests were carried out by the testing of the wire as a rotating cantilever, by gripping one end in a self-centring chuck rotated by an electric motor and loading the outer end by dead weights. The steel was more

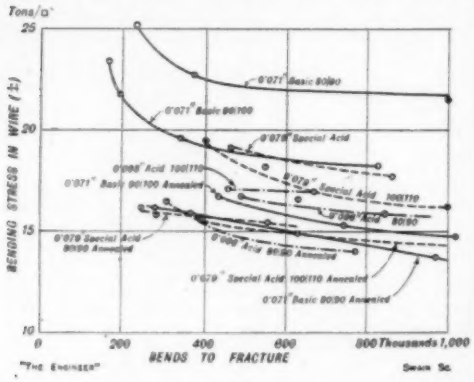


FIG. 3

heavily stressed at the chuck end, where the bending moment was at a maximum during a revolution the stress at the periphery changed according to a sine law from maximum tensile to maximum compression and returned to the maximum tensile stress. Conditions corresponded nearly to reversed bends. Some of the results of these tests are plotted in Fig. 3. The fatigue stresses on the basis of a million reversals are tabulated in Table IV.

TABLE IV.—*Fatigue Tests on Wires.*

Diam. of wire, inches.	Tensile strength, tons per sq. in.	Quality.	Fatigue stress wire as received, tons per sq. in.	Fatigue stress wire annealed, T/ns per sq. in.
0·071	80 to 90	Basic	±21·6	±13·6
0·096	80 to 90	Acid	±15·6	±13·9
0·079	80 to 90	Special acid	±17·2	±14·7
0·071	90 to 100	Basic	±19·2	±14·8
0·065	90 to 100	Acid	±17·1	±13·1
0·095	100 to 110	Acid	±16·9	±14·6
0·079	100 to 110	Special acid	±16·4	±14·4

In all cases up to one million bends the fatigue limit of the wire is reduced by annealing. The treatment received by the wire during drawing also has an effect, which was apparent under test conditions.

The present method of determining the working tension on a rope working over a pulley or drum by adopting a factor of safety taken as the breaking strength divided by the tension on the rope is, it is pointed out, wrong. It is recommended that the direct tensile stress be calculated by dividing the rope tension by the total section of the main wires, excluding the soft core wires, and the bending stress from 13,000 d/D or 13,000 divided by the ratio of the pulley to the largest wire diameter. The sum of these stresses gives the maximum stress operating in the wire which should be kept under the fatigue limit for the wire.

The principal findings of the report are conveniently given in the following summary :—

SUMMARY.

Twelve wires to a strand with a fibre core was the best construction when associated with Lang's lay.

Ordinary lay was best for nineteen-wire strands, 12 on 6 on 1, except on the pulley of 850 wire diameters.

A soft core wire in a seven-wire strand proved to be undesirable for a rope of high-tensile wire which was used on a small pulley.

A Lang's lay rope with strands of six 100 to 110-ton wires laid on a soft core wire was best on a large pulley of 500 wire diameters, but even on this pulley the soft core wire was a weakness in the 80 to 90-ton rope.

The higher tensile wire ropes of the smaller 0·021in. wire worked under somewhat higher tensions than the corresponding 80 to 90-ton ropes, but there was no distinct superiority with the seven-wire strand ropes.

6 × 6 and 6 × 7 ropes compared favourably with 6 × 12 and 6 × 19 on the same pulley when its diameter equalled 500 diameters of the larger wire, or 18 circumferences of either rope.

A pulley of less than 300 wire diameters misused a rope which lasted only whilst the ductility of the wire was being destroyed.

When a rope failed after a quarter of a million bends the load carried with reversed bends was less than three-quarters the tension when the bends were all in the same direction, or, alternatively, the number of bends was halved at the same tension on the rope.

Trulay ropes were superior to those made by the usual method of manufacture particularly on small pulleys and in 6 × 7 construction.

The Lang's lay ropes with twelve wires to the strand on a fibre core gave particularly good results on pulleys of 500 wire diameters and larger, and under these conditions the alleged deformation of this form of rope will not occur.

The tensile strength of a wire was reduced 18 per cent. by severe lateral pressure.

A considerable number of twists did not affect the behaviour of a wire under tension or tension with repeated bending over pulleys, but a maintained torque weakened a wire in tension.

Repeated bending over pulleys of a wire under increasing tension caused a much greater elongation at fracture, but the excess became less with more bends.

The fatigue strength of acid wires had always the mean value of approximately ± 17 tons per square inch by repeated bending as a cantilever. Annealing the wires caused only a small reduction to a mean value of about ± 14½ tons per square inch. The high tensile strength given to wire by drawing had little effect on its fatigue strength.

The conditions of rope service may best be considered on the basis of the sum of the tensile and bending stresses being within the fatigue range of the wire. The factor of safety need only be used as an additional check when the pulley or drum used is exceptionally large.

Work in Progress.—A beginning has been made towards checking the results from the 1in. circumference ropes by tests of larger specimens. A machine is at work which takes two 2in. circumference ropes and another is under construction to bring the total to four. It will be possible to examine still more flexible constructions in the larger size which can now be handled.

High Powered Diesel Engines for Peak Loads.

ON Tuesday evening last, May 1st, Mr. M. Gercke, technical advisory engineer on power station practice to the Maschinenfabrik Augsburg-Nürnberg A.G., dealt in a paper read before the Diesel Engine Users Association, entitled "Some Considerations Regarding the Peak Load Problem and High-powered Peak Load Diesel Engines," with some aspects of the peak load problem and its solution by the adoption of Diesel engines of high power. In introducing his subject Mr. Gercke compared the Electricity Act of 1926 with similar practice in Germany, and stated that according to the latest statistics 75 per cent. of the electricity supplied in Germany in 1927 was produced in power stations which were owned exclusively by public bodies, including the Government, Government Departments of Federal States, municipalities and industrial enterprises. An Electricity Act, as such, did not exist in Germany, and efforts to deal with this mainly economic question by the Government had failed, in view of the general opposition raised.

In the northern and western districts of Germany, it was pointed out, large steam power plants operated on black or brown coal form the backbone of the electricity supply system, while in South Germany the main stations comprise water power installations with steam stand-by as peak load plants. By means of diagrams and tables Mr. Gercke explained the load conditions of some typical plants, exhibiting typical load diagrams. From the curves published by the Central Electricity Board for the South-East of England area the division of the aggregate load into (1) a three-shift base load of the first order constant for the whole of the 8769 hours per year, (2) a two-shift base load of the second order constant for, say, fourteen to sixteen hours per day, excluding weekends and holidays, say, 4500 to 5000 hours per year ; (3) a one-shift peak load of the third order, say, 500 to 1100 hours, was explained.

Fig. 1 shows a model made of the aggregated individual load diagrams for 365 days of the year 1927 for the Berlin Municipal Electricity Works, and it depicts in a striking way the base loads of the first and second orders, indicated by the general levels, and also the superimposed peak loads of the third order, represented by the sharp peaks.

According to international statistics and the experience of large cities and industrial districts, the author said, the units generated to cover the base loads of the above-mentioned first and second order amount to approximately 95 per cent. of the total supply. Owing to the more even distribution over a large period this demand can be met by only 50 per cent. of the power station rating during peak load periods.

The peak load consumption actually demands only about 5 per cent. of the total supply, but it requires certainly not less than the balance of 50 per cent. of the maximum rating. The resulting bad load factor and generally reduced operating efficiency of a station resulting directly from the above-mentioned conditions were then discussed and analysed for typical German power stations. In one large German power station 30 tons of coal were consumed for heating up the boilers for a peak load of 12,000 kW for four hours a day, while in another station about 21 tons of coal are used for heating up the boilers for two peak loads per day, each of 6800 kW.

The author then went on to discuss the economic effect of peak loads on the efficiency of steam power plants. He pointed out that in addition to the load factor there is another factor which may be considered as a practical standard for judging the generating conditions of power plants from the economical point of view. This is the time factor of the maximum demand, *i.e.*, the number of hours per year to which the total power production in kWh may be reduced, supposing it were generated with the constant maximum demand.

$$\text{Time factor} = \frac{\text{kWh per year}}{\text{maximum demand in kW}} \text{ in hours per year.}$$

The higher this theoretical figure was the better were the operating conditions, because the power plant works more favourably with a higher utilisation of its capacity and output. This so-styled theoretical figure was therefore, the author thought, really a valuable practical standard of comparison and could be applied successfully for economical calculations.

In the following table the time factors and load factors for the maximum demand are worked out for the three schemes, South-East England, Central Scotland, and

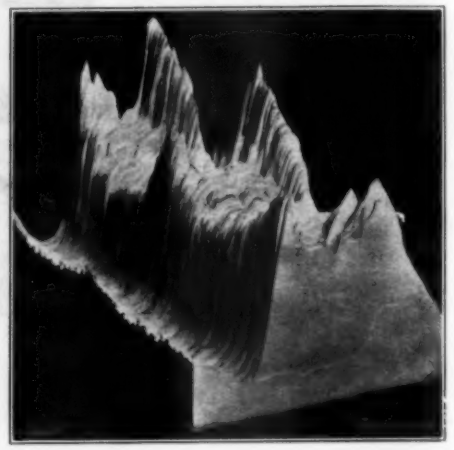


FIG. 1—A "LOAD MOUNTAIN" MODEL

Central England, so far elaborated by the Electricity Commission. The figures published in the supplementary particulars "*a*" are compared with calculated figures "*b*," which are arrived at according to the suggestions put forward in the paper that the total production be divided so that the three and two-shift loads are generated by steam plants only and the peak loads by special prime mover units. The improved time factors and load factors of the maximum demand may be noted.

TABLE I.—*Time Factors and Load Factors of the Maximum Demand of the Three Districts as Proposed in the Reports Issued by the Central Electricity Board.*

I.—*Time Factors in Hours Per Year.*

	Hours per year.		
	S.E. England Electricity Scheme, 1927.	Central Scotland Electricity Scheme, 1927.	Central England Electricity Scheme, 1928.
(1) March, 1934—			
(*a*) Total installation	2450	2930	2760
(*b*) Base load units alone ..	4660	5560	5225
Difference in favour of (*b*)	2210	2630	2465
(2) March, 1941—			
(*a*) Total installation	2560	3915	2860
(*b*) Base load units alone ..	4860	5725	5425
Difference in favour of (*b*)	2300	2710	2565
Peak load units alone—			
(1) March, 1934	245	293	275
(2) March, 1941	256	302	286

II.—*Load Factors of the Maximum Demand (Per Cent.).*

(1) March, 1934—			
(*a*) Total installation	28·0	33·5	31·5
(*b*) Base load units alone ..	53·1	63·5	59·6
Difference in favour of (*b*)	25·1	30·0	28·1
(2) March, 1941—			
(*a*) Total installation	29·2	34·4	32·6
(*b*) Base load units alone ..	55·5	65·3	62·0
Difference in favour of (*b*)	26·3	30·9	29·4
Peak load units alone—			
(1) March, 1934	2·8	3·34	3·14
(2) March, 1941	2·9	3·44	3·26

In connection with the above table the diagram Fig. 2, taken from the paper, may be referred to, which illustrates the relations between load factor, time factor of the maximum demand, heat consumption and generating cost per kWh of steam power plants. Considering two special cases, the author showed that the economy of power generating would be increased by cutting off the peak loads as follows :—The load factor increased from 28/29·2 per cent. to 53·1/55·5 per cent.; the time factor of the maximum demand increased from 2450/2560 hours to 4660/4860 hours per year ; the heat consumption reduced from about 21,000 B.Th.U. to about 18,000 B.Th.U.

per kWh; the generating cost per kWh reduced from 100 per cent. to about 70 per cent.

Assuming 3,727,000,000 units per year—the consumption of the South-East England District in 1933—these figures mean a reduction of the coal consumption of about 385,000 tons per year, corresponding to a reduction of the generating cost of the total production of electricity at a rate of approximately £230,000 per annum. The production of the peak load—5 per cent. of the total consumption—is, of course, not included. This must be considered separately according to local circumstances and must be deducted from the amount saved in accordance with the above-mentioned calculations.

The next section of the paper dealt with the different peak load equipments and considered the various types of plant, steam turbine, oil engine and gas engine for primary peak load supply, mentioning only briefly

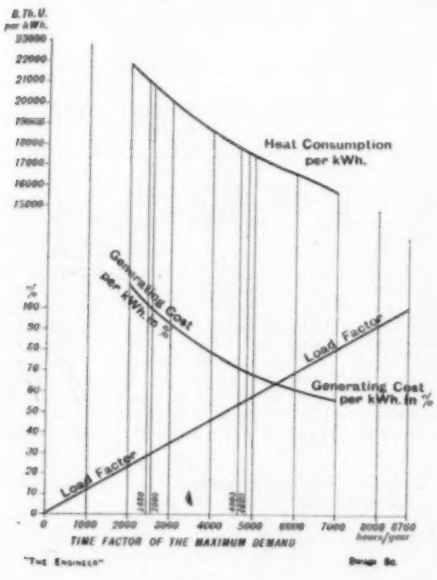


FIG. 2

accumulators for steam, hydraulic power or batteries which might be employed in meeting the requirements of secondary peak loads. It was pointed out that primary plants can fulfil the double purpose of peak load services and stand-by services. In discussing steam-operated peak load plant Mr. Gercke did not consider that a satisfactory form of steam plant for peak load purposes having the requisite quick starting and shutting down qualities and flexibility has yet been developed. For this reason he advocated the high-powered Diesel engine and showed plans of two 7500 B.H.P. M.A.N. type nine-cylinder two-stroke double-acting engines with air injection driving a centrally placed three-phase alternator at 250 r.p.m. Such engines, he said, could now be supplied in units up to 10,500 kW at 94 r.p.m., or 7500 kW at the higher speeds of 215 to 250 r.p.m. with airless injection. The initial costs of such plants in Germany, including the electrical equipment and building, but not the site, were for slow-speed engines about £16 10s. per kW installed and about £11 for the high-speed plant. The fuel consumption was from 0·55 lb. to 0·575 lb. per effective kWh. Diesel engine peak load plants are now installed at Hamburg, Berlin, Bremen, Wurzburg, Halle a. S., Kottbus, Erlangen, Bayreuth, Quedlinburg, Nordhausen, Goslar, Groeba, Villingen, and other cities of Germany.

Figures for the 10,000 kW Hamburg plant for the two winter seasons 1926–1928 were quoted by Mr. Gercke to show that the peak load is produced at from 0·53d. to 0·58d. per unit inclusive of fuel costs—£5 c.i.f. Hamburg—and capital charges with an annual plant factor of 9 per cent. based on a time factor of 1100 hours per year. Keeping in mind the economical advantages offered by the Diesel engine running in conjunction with steam power plant and cutting off the peaks, it is expected that the costs of the Hamburg Diesel engine plant will be repaid by the resultant economies in from five to six years, without considering the useful purpose of the engine as a stand-by set, which is always ready for service. The same favourable figures are expected from a 15,000 kW peak load installation at Berlin which will work in a sub-station in connection with a 60,000 kW steam turbo-generator plant. In this case it was shown that the net saving will be £32,000 per year, allowing for the running of the Diesel plant, which will repay the initial capital expenditure for the peak load installation in five years, making no allowance for the value of the Diesel engine generators for service as stand-by plants.

Some additional advantages of peak load Diesel engines to which Mr. Gercke referred included the fact that the Diesel engine does not use the same fuel and transporting machinery as the steam base load plant, and that it can be operated with a minimum of skilled labour in case of strikes. Further, the reliability of the supply is improved by keeping the base load sets free of peak load demands. Reference was made to the proposal to use the West Ham station as a peak load station, which was referred to in an article published in THE ENGINEER of January 20th last. Tables were shown in which the generating cost was given as varying from 1·57d. to 5·67d. per kWh over the period 1928–1929 to 1933–34. Whereas for the Berlin plant above referred to the cost per peak load used is only 0·895d. when generated by Diesel oil engines.

In the following some notes are given by the author as to the requirements of installation.

Installation of Peak Demand Diesel Engines.—The entire arrangement of Diesel peak load installations should be as simple as possible. All devices for operating the engines must be combined, coupled and interlocked in such a manner as to make them absolutely fool-proof. Every precaution must be taken to avoid trouble owing to mistakes likely to be made when starting up the installation, without notice, as in case of emergency.

The equipment of such Diesel engine installations should include in addition to the main Diesel sets :—

(*a*) The compressed air plant. Air reservoirs for starting the engine and a compressor, operated by an electric motor or by a small Diesel house set coupled to a stand-by dynamo. For cases of emergency cylinders of carbonic acid (CO_2) could be held in readiness.

(*b*) Fuel tanks for storing the fuel for several months; service tanks for feeding the fuel injection pumps on the gravity system; fuel oil transfer pumps with motors and accessories.

(*c*) Lubricating oil tanks with cooling and filtering equipment and pumps.

(*d*) Cooling water plant with cooling towers, if required, and pumps.

(*e*) Scavenging air plant comprising separately driven turbo-blowers, coupled to three-phase alternating-current electric motors; for small and medium-sized sets, directly coupled piston blowers, the scavenge air should be supplied through ducts with dust filters at their terminal points to the atmosphere.

(*f*) Exhaust through silencers and exhaust tanks with chimneys for discharging the exhaust gases as high as possible above the power station building.

(*g*) Special devices for positive starting of the Diesel engine in case of breakdown of the alternating-current supply, which is used for starting the scavenging blowers. Provision of a small direct-current storage battery for exciting the generator when starting up the Diesel engine, in order to secure the automatic working of the motor of the scavenging blower together with the Diesel engine and the main generator. As a substitute for the storage battery the Diesel house set with the stand-by exciter may be used for this purpose.

With reference to the above some experiments with the Hamburg engine may be mentioned. They proved that rapid starting of the engine can be satisfactorily carried out with compressed air alone and without any alternating-current supply for driving the cooling and lubricating pumps. A speed of 60 r.p.m. was secured in this manner; sufficient to start the scavenging blower and the other auxiliary machinery. Soon afterwards the engine attained its full speed and could then be loaded. This experiment, which was repeated several times, shows that the Diesel engine is a self-contained unit and that it is not necessarily dependent on any alternating-current supply for starting.

(*h*) Special arrangements for securing practically noiseless service when the plant is situated near residential quarters, *i.e.*, medium-speed scavenging blowers, carefully silenced; scavenging air supply at moderate speed; baffles in the suction channels for silencing the noise from the air inlets to engine.

In discussing future developments the author suggested that quick-running units—faster than the 250 to 300 r.p.m. large units of to-day—may be used if cost, weight and space is thereby saved. Against these advantages the increased cost of high-class materials necessary for high-speed engines must be set off. Finally an appendix to the paper, in which the application of high-powered gas engines for peak load work was discussed. It was shown that such plant demands a heat consumption of 14,500 B.Th.U. per kWh, against 10,300 B.Th.U. for the Diesel engine. The initial cost of gas engine plant in Germany, based on 7000 kW output, was given as £12 10s. per kW installed, as compared with £11 for a high-speed Diesel engine. If fuel oil for the latter plant costs 130s. per ton, then the equivalent price of gas at the gasholder may be 11d. per 1000 cubic feet for the same generating cost.

Books of Reference.

"THE Empire Municipal Directory and Year Book" for the year 1928–1929 has recently been published, and is prefaced by a foreword written by Sir Henry Maybury. This very useful work of reference, which is published at the offices of *Municipal Engineering and Sanitary Record*, 8, Breams-buildings, London, E.C. 4, price 10s. 6d. net, is now in its forty-sixth year of publication, and the present volume appears to be every bit as full of valuable information as have been its forerunners. It is, as usual, divided into sections. The first is a directory of local authorities in England and Wales, Scotland, Ireland, the Isle of Man, and the Overseas Dominions, Dependencies, &c., and it is, we believe, unique of its kind, no such complete list being to our knowlege available in any other single publication. The remaining sections are :—II., Road Construction and Maintenance; III., Plain and Reinforced Concrete and Cement; IV., Lighting, Heating and Ventilation; V., Municipalities and Motors; VI., Water Supply, Purification and Softening; VII., Sewerage and Sewage Disposal; VIII., Municipal and Public Health Law; IX., Public Cleansing and Waste Utilisation; X., Fire Prevention; XI., House and Town Planning; XII., Labour-aiding Plant and Appliances; XIII., Public Recreation Grounds; XIV., Municipal Engineering, Public Health and Scientific Societies; XV., A Municipal Engineering and Sanitary Trades Directory. With regard to those sections which specially concern engineers, we can say that they appear to have been brought well up to date. Finally, there is a "week-to-a-page" diary. Altogether, it is a most useful book to have by one.

"CHEMICAL Engineering and Chemical Catalogue," which is published by Leonard Hill, Ltd., 173, Fleet-street, London, E.C. 4, price 10s. 6d., appears this year in its fourth edition. We have had some nice things to say about this book in connection with previous issues, and the present issue only confirms us in the view that we said those nice things with justification. It is, as we have pointed out, far more than just a mere catalogue. Indeed, it claims for itself to be designed as a "standard text-book of reference for consulting and contracting engineers, works managers and others charged with the specification and purchase of the plant, equipment and material utilised in the manufacture mainly of consumable products." That definition far better describes its scope than does its actual title. The present issue contains, first of all, a catalogue of chemical manufacturers and their chief products. It is followed by a similar catalogue of firms which manufacture plant and equipment used in chemical manufacture and engineering. Then follow, in turn, a classified index of chemicals and plant with the names, in each case, of the firms which supply them; a list of trade marks and trade names; and an index to the industrial applications of chemicals, &c. Finally, there is a section devoted to tables and data, and another containing lists, &c., of scientific books. It is certainly an excellent work of reference.

"THE Colliery Year Book and Coal Trades Directory," 1928, is published by the Louis Cassier Company, Ltd., 22, Henrietta-street, Covent Garden, London, W.C. 2, price one guinea net. In the preface to this year's issue it is pointed out that the present edition is the sixth since the institution of the publication, and that the contents have now become stabilised. Consequently, no new features have been added, but the book has been thoroughly revised in every section. It contains, first of all, lists of officials in the Mines Department and otherwise interested in mining matters, and then a list of colliery owners with the numbers of men they employ, &c. Then follow :—An index to mines; a section devoted to mines regulations, &c.; an article on "Electrical Development relating to Coal Mines," and another on the "Coal Problem of 1928"; a section concerned with the coal market and schemes; a review of the Coal-mining Industry in 1927; and a review of the coal trade in 1927. About 130 pages are then given up to statistics regarding coal and coal-mining, which are succeeded by a Collieries' Who's Who; a bibliography of periodical literature on coal mining; a list of books on coal mining; a diary of events; lists of blast-furnaces, coke makers, gasworks, and electricity supply undertakings, and a Coal Trades Directory.

"SELL'S Directory of Registered Telegraphic Addresses, 1928," which is published by Business Directories, Ltd., 8 and 9, Johnson's-court, Fleet-street, London, E.C. 4, price 45s., is certainly one of the most frequently consulted books of reference on our shelves. There is no need nowadays to point out that as the directory is compiled from lists supplied bythe authority of the Postmaster, generally it is accurate. If we may judge by ourselves, no inaccuracies have ever been found in any of its precursors; certainly, we cannot call to recollection having found one. The present volume, in addition to some 100,000 telegraphic addresses, contains a good deal of most useful information which has not been included in previous issues. One of the new features is a reference back indicator, by which the name corresponding to a code number can be readily found. It is worthy of note that though the present volume is, as its publishers claim, "packed more closely with facts and figures adjusted to the business man's requirements," it is by no means unwieldy to handle. Indeed, its size is much more convenient than that of the volumes of a few years ago before the change in type was made.

"THE South African Mining and Engineering Year Book." Edited and compiled by S. R. Potter and J. B. Bullock. London: Argus South African Newspapers. 10s. 6d. 1928.—This useful year book is larger than ever, and now contains nearly 600 pages. It has, of course, been revised, and includes sections dealing with electrical engineering, mechanical engineering, railways and transport, and mining, while there is a special division for Rhodesia and the Congo. There are also lists of overseas manufacturers represented in South Africa, British overseas manufacturers, exporters to South Africa, municipal, mining, railway and industrial buyers, and consulting engineers in South Africa and Rhodesia. In a review of progress in engineering, it is claimed that, in many respects, the mining industry, and particularly the Witwatersrand section thereof, is leading the world, and that electrical and mechanical engineering, as applied to the industry, is on an equally high plane. A large map of the Rand goldfields is included in the book.

"REID'S Handy Colliery Guide and Directory." Newcastle-on-Tyne: Andrew Reid and Co. 3s. 6d. 1928.—This little guide is confined to the counties of Northumberland, Durham, Yorkshire and Cumberland, and gives a complete list of all the coal pits with the names of the agent, manager and engineer. The nearest railway station is also given. A separate list is used for the addresses of the officials, and there is an alphabetical index of the collieries. There follows a list of the associations and societies connected with the coal trade, another of H.M. Inspectors of Mines. There are extracts from the Acts governing mining, a new formulæ, and an excellent map of the district.

"GUIDE to Rhodesia." Issued by authority of the Beira and Mashonaland and Rhodesia Railways. Bulawayo: Davis and Co. 2s. 6d. net.—This is the second edition of a very fascinating guide, designed principally for the benefit of the tourist and sportsman. There is, however, a considerable section devoted to agriculture and industries, while some historical notes are most interesting, and show how ancient is the gold mining industry of the country. The guide is profusely illustrated with good half-tone engravings and maps.

"THE Year Book of the British West Indies." London: *The Canadian Gazette*. 7s. 6d. net. 1928.—This is the second year of publication of the year book, which covers not only the British West Indies, but also the Bermudas, the Bahamas, British Guiana and British Honduras. There is also an appendix dealing with Cuba, Santo Domingo, and the Dutch and French West Indies. The information given is of the style generally included in such works, and is most complete. The book is brightened up by a number of reproductions of local photographs.

A New Traffic Signal.

To what extent any signalling device can be employed in this country for the ordinary regulation of crossing streams of traffic is a question that is still undecided. Many types of electric signals with red or green lights have been tested in London, the lights either being attached to a standard or other erection or fastened to the constable's arm or hand. Lights have also been attached to the front and back of the constable by means of shoulder straps, and a white light has been provided in addition to red and green lights as a warning to get ready. Experience has shown, however, that the three-light system is unsatisfactory; in fact, it may be said that the more elaborate the signalling system is made, the less useful it becomes. Those who imagine that London has lagged behind other cities in the matter of testing signalling devices for regulating the traffic may be interested to know that the first device was tested nearly sixty years ago.

Any signal devised for this purpose must comply with certain fundamental requirements. It must be absolutely simple and must indicate in an unmistakable manner the instructions the constable wishes to convey; it must attract the attention of vehicle drivers or other users of the road, and in the case of any failure of the mechanism, the danger signal must be automatically given. With these considerations in view, the engineering department at Scotland Yard has been experimenting for some months past with the signalling apparatus shown in Figs. 1 to 3, which has been designed to comply with the above requirements. That the device is perfectly satisfactory from a

FIG. 1—SIGNAL AT "ALL CLEAR"

technical point of view, there seems to be no doubt, but experience has shown that the public will require considerable education before the traffic can be satisfactorily controlled by mechanical means. Many do not appear to grasp at once what the signal means, and there is an irresistible impulse not to stop immediately the signal indicates that the approaching vehicle is to be brought to rest, and to imagine that there is just time to get through and avoid waiting for the next all-clear signal.

Coming now to the technical details of the apparatus, a steel drum, 2ft. in diameter and 12in. deep, is mounted on a pedestal of fairly heavy design, and at the top of this drum there are two dioptric cut lenses, which are illuminated alternatively as the main signal on the front of the drum changes from safety to danger, and gives a green and red light to indicate "all clear" and "danger" respectively. The face of the drum is provided with two revolving discs—Nos. 1 and 2, Fig. 4—and behind these discs there is a diaphragm—No. 3, Fig. 4—which is attached to the drum. The disc No. 1 has two openings shaped to correspond to a signal arm at the danger position, and above these openings is a segment of a circle. The No. 2 disc has two openings, and above these openings the word "Stop" is printed in large red letters; whilst below the openings and at right angles to the word "Stop" are the words "All Clear." The two discs are mounted on a common axis, No. 1 disc being superimposed on No. 2, and on being made to turn through 90 deg. in opposite directions alternately, *i.e.*, clockwise and anti-clockwise, they either show the vertical green signal at safety with the words "All Clear," or the horizontal red signal at danger with the word "Stop." The movements of the discs are controlled by a bevel gear, which is mounted on a ball race to ensure easy movement. A 24-volt accumulator supplies current to a small electric motor, with an electric clutch, which provides the necessary power. A rack and pinion are employed for rotating the discs in a clockwise and anti-clockwise direction, the discs being weighted so that if the current is switched off by the control button or fails, the signal automatically takes up the danger position. This would naturally have a tendency to drive the motor in the reverse direction, but when the circuit is opened, the electric clutch uncouples the motor, whilst the rack and pinion continue to mesh with one another, the pinion being mounted on a double ball race. The control board from which the constable operates the signals consists of a waterproof case on which there are push buttons, which control relays, which, in turn, close the motor and clutch circuits. If the signal is standing at "Stop," and it is desired to alter it to "All Clear," by means of one of the press buttons a current is sent from the battery through a relay, which, in turn, closes the motor and clutch circuits. The motor then starts and drives the pinion, which, in turn, moves the rack through

FIG. 2—SIGNAL AT "DANGER"

90 deg. No. 1 disc revolves in a clockwise direction and No. 2 disc in an anti-clockwise direction, until they reach the end of their travels, where they remain. When the "Stop" button is pressed, the clutch is de-energised, and the two discs turn by gravity in the reverse direction back to "Stop." The control board is so constructed that while it is possible to place both signals at "Stop," it is

FIG. 3—BACK OF SIGNAL

impossible to set them both at "All Clear." Attached to the spindle of No. 1 disc is an ebonite drum with electrical contacts, which controls the red and green lights to the top of the apparatus. At night the dial is illuminated by twelve 1¼-watt lamps around the circumference of the discs. The signals that have been tested have an electric bell fitted at the back, which can be rung by pressing a button on the control board. At present the apparatus has only been used in places where the road has been under repair, and the question of whether the

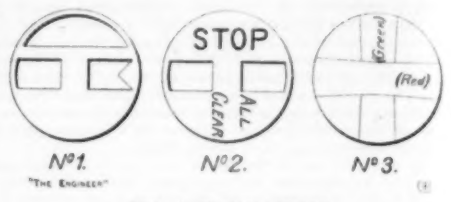


FIG. 4—SIGNAL DISCS

system will be employed for the control of traffic to any marked extent appears at the moment to be a matter of uncertainty.

The Burden of Local Taxation.

FOR the convenience of our readers who are interested in the Chancellor of the Exchequer's scheme for the reduction of the burden of rates on productive industry, we publish the following *précis* of a memorandum issued by the Engineering and Allied Employers' Association a few weeks ago.

How industry is hampered by intolerable burdens is admirably shown by the Engineering Employers' Federation in an official statement issued to all federated firms. It is packed with facts and figures proving the case for some relief. In the very introduction is placed the fact, vouched for by Sir Arthur Balfour's Committee on Industry and Trade, that the money cost of local rates and services per unit of output has at least trebled since 1913. In addition to the increase in local taxation there is the increase in the cost of social services and the increase in unemployment and the cost of unemployment which have to be borne by industry.

Discussing the burdens in detail, the statement refers to the enormous growth of the unemployment burden. At this moment the Unemployment Insurance Fund is in debt to the tune of £24,000,000. Before the war the total sum paid to this Fund by employers and employed was about £1,600,000 a year. In 1924–25 these contributions had risen to £36,700,000, and the State contributed £13,000,000. All this money has to be earned by industry.

Turning to local rates, the authors point out that industry probably contributes directly not less than one-fourth of the total rates of Great Britain. In 1914 these amounted to £79,000,000; in 1926 the total amount levied was £166,000,000. Rates per head of the population in 1913–14 were £1 17s. 10d.; in 1926 they were £3 15s. 10d., an increase of 100·4 per cent. Even at the values of 1925 the rates per head of the population would have been £3 0s. 6d. in 1914 and £3 15s. 10d. in 1926, an increase of 25 per cent. In 1927 for the whole of Great Britain the rates were probably £180,000,000. One-quarter of this—the proportion paid directly by industry—is £45,000,000. Approximately one-third of the local rates raised was spent last year on Poor Law relief. If we add public social services the proportion is approximately one-half. But in 1913 only 16·8 per cent. of the total rates was expended in relief of the poor. In the year 1927 the sum so spent is estimated at £54,000,000—approaching one-third of the local rates levied. Since 1919 the nine years have swallowed up over £35,000,000 in Poor Law relief. In addition many Boards of Guardians have borrowed huge sums. Many persons are in receipt of Poor Law relief plus unemployment benefit.

An interesting table included in the statement shows the total effect on a ton of steel of local rates, plus workmen's compensation, plus national insurance. The instances given are taken from the books of a number of firms. The effect of these comparisons may be seen from one example:

	1913. s. d.	1923. s. d.
Local rates	2 3	6 0
Workmen's compensation	1 5	2 6
Insurance	0 6	2 7
	4 1	11 1

In this case a ton of steel plates bore a burden of 4s. 1d. in 1913 and now has to carry a burden of 11s. 1d., an increase of 171 per cent. The authors declare that the engineering industry, contributing directly or indirectly the cumulative load of rates and social charges payable in respect of raw or semi-manufactured materials, is burdened to the extent of at least 9 to 10 per cent. of the selling price of its products.

A demand is made for a more exact analysis of the million and a-quarter unemployed and the extent to which these are a proper burden on current industrial activity. The "sample" analyses of the Ministry of Labour are declared to be "neither satisfactory nor conclusive," and it is stated that no satisfactory method of dealing with this measure of unemployment can be arrived at until a proper analysis is made. Such an analysis would show the real composition of the unemployment figure, how many "misfits" due to the war are being carried, how many are physically capable of performing the work they claim to do and so forth.

The debits of the Unemployment Fund and of the Poor Law will have to be repaid. In each case the call will be made on the workpeople as well as on the employers. There is nothing so depressing as having to pay off a debt. The real value of wages is continuously depressed, and the costs of production increased.

It is suggested that the "dead load" both of men and money should be separated from the current load. If that were done methods of dealing with the dead load could be decided.

"Industry," concludes this memorandum, "which is the foundation of the prosperity of this country, is really in a death struggle. Is it not right that its illness should be carefully and accurately diagnosed and an appropriate remedy applied?"

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Helping the Basic Industries.

IRON and steelmasters, manufacturers and engineers in the Midlands and Staffordshire received with acclamation the Chancellor's proposals to reduce the burden of rates and cheapen transport. The proposals have been ably described as "a message of good cheer to the basic industries," and to say they were warmly welcome would be but a mild description. It is a case of help where most needed. The Budget will certainly encourage industrialists in this district, many of whom have been going through a most trying time, to make every effort to carry on until the time of fulfilment of Mr. Churchill's promised relief arrives.

Staffordshire Iron.

The improvement at the Staffordshire finished iron mills is maintained, and since I last wrote rather more business is reported to have been negotiated by the marked bar houses on the new basis of £12 per ton. Business in Crown quality bars is rather slow, the disparity in quotations being responsible for the unsettled influence. While outside makers quote Crown bars at £9 5s., Staffordshire mills will not go below £10. Belgian No. 4 iron is quoted at £7 17s. 6d. delivered, but has a very small sale. There is a wide difference in quality between No. 4 and No. 3, and the price shows a decided advance as compared with good quality Staffordshire iron. Buying of continental material is on a small scale generally, and shows a big falling off as compared with a year ago. Nevertheless the bulk of the iron used in the nut and bolt works is foreign owing to the substantially lower price of imported material. At the moment Darlaston and other users of Belgian bars are refusing to pay the £6 5s. 6d. now asked for this material. They ask for a reduction of at least 5s. per ton, and this sellers are not disposed to concede. Tube makers in this area are busy, and the tonnage of strip iron and steel required shows a steady expansion. Iron strip is now down to £11. Steel strip is quoted £7 10s., which is only 15s. per ton above continental prices. There is a good deal of German finished tubes coming into the Black Country, but the mills making steel tube strip are able to hold the trade fairly well.

Raw Iron.

Although output of pig iron in the Midlands is restricted as far as possible, smelters' stocks are inclined to accumulate so limited is the inquiry. These increasing stocks have aggravated the difficulties of blast-furnacemen. A fair number of them are holding on to their prices in the belief that demand will not be improved by further concessions, but some weakening of the position has taken place. Northamptonshire No. 3 has this week been sold at £2 18s. 6d. Derbyshire, however, maintained its price at £3 3s. 6d. to £3 4s., and North Staffordshire £3 2s. 6d. Small quantities of superior Welsh pig iron are being bought for high-class castings. This material much resembles Scotch iron, but is obtainable at something like £1 1s. per ton cheaper on account of the more favourable rail charges. Scotch iron is selling at £3 9s. to £3 10s. at the furnaces, and a little of this material is finding its way to the Midlands.

Steel.

Midland steel mills are doing fairly well. The demand for steel for miscellaneous requirements is increasing, although the structural demand is disappointing. It does not improve as it should do, taking into account the customary activity at the structural yards at this time of the year. A marked improvement has taken place in the orders for high carbon billets, in which Sheffield has taken a strong lead. Buyers would be glad to place much larger contracts with steel firms specialising on this high-class material than the makers are now prepared to accept. Other departments of the steel market are quiet. Continental prices are firm, and bars are quoted up about a shilling this week. Germany has again withdrawn from the market so far as some classes of material are concerned. British steel mills can give quick delivery, and a good deal of business is being retained at home. Continental sellers this week quoted £4 16s. for joists, £5 10s. for channels, £5 4s. for angles, £5 5s. 6d. for bars, all f.o.b. Antwerp. Little business is being done in bars, buying being carried on chiefly by stocking merchants. Joists are not attractive in the Birmingham district, but it is believed that considerable quantities are being shipped to Manchester.

Sheets and Tin-plates.

The overseas demand for galvanised sheets has fallen off so considerably that manufacturers have hard work to maintain the basis at £13 for 24-gauge, f.o.b. They have declined orders, however, rather than submit to further depreciation. Deliveries are now being offered within three or four weeks, an indication that the reserve of work in hand is diminishing. A special reduction of 10s. has been made in 30-gauge sheets, namely, from £18 5s. to £17 15s. The makers of tin-plate are full of work, and many mills are fully booked until August. Welsh tin-plates are offered at 18s. to 18s. 3d., but the associated manufacturers have not deemed it wise to interfere with the official minimum of 17s. 9d. There is only a slow demand in this district.

Scrap.

Heavy steel scrap is firm at £3 2s. 6d. delivered South Wales. Demand from that quarter is much brisker than from Sheffield. Birmingham merchants have in many cases sold at £3 5s., and have even quoted up to £3 7s. 6d., but no business at the latter figure can be traced. Sales for export are on a considerable scale, and many merchants consider the Government should prohibit the export of this material.

Vertical Retort Installation.

Last week saw the initiation of the new vertical retort installation at Saltley Gasworks. The new plant has a capacity of 7 million cubic feet of gas per day, compared with 2½ million cubic feet of the old retorts. In order to avail itself of as wide a range of coals as possible, while yet maintaining satisfactory carbonising results, the Gas Department has installed an entirely new feature in gasworks practice in the provision of a reinforced concrete coal-blending hopper with a capacity of 2000 tons. This hopper is divided into four sections, so that, when desired, different qualities of coal may be blended. The coal-crushing, elevating, and conveying plant is capable of dealing with 100 tons of coal per hour.

Will Coal Replace Oil?

That in the future they would find coal replacing oil for power-producing purposes, and, he hoped, for road vehicles, was the view expressed by Professor K. N. Moss, chief lecturer on Mining in Birmingham University, at the annual dinner of the Coombes Wood Colliery Branch of the Hingley A.C., on Saturday last. The industry, he admitted, was in a bad way, but it had passed through worse times. The British mining industry led the world, and he was convinced that the British miner and the mining engineer could see the industry through its present problems. Since the war mechanical engineers had thought in terms of oil; they wanted to make them think in terms of coal. He thought the time would come when coal would be increasingly used instead of oil in the mercantile marine. He wanted to see all lorries and omnibuses run with coal, and he thought that that would come about. He was certain that in the future they would find coal replacing oil, especially for power-producing purposes, and, he hoped, for road vehicles. There was, in his opinion, a great future for the mining industry.

Proposed Drainage Board Works.

The Works Committee of the Birmingham Tame and Rea District Drainage Board recommends the application to the Ministry of Health for sanction to loans totalling £82,000 for extension of works. It proposes to spend £40,000 on extending the bio-aeration plant at Minworth; £18,000 on enlarging the sludge gas power plant at Saltley; £21,500 on the duplication of the electric power line between Saltley works and Minworth; and £3340 for the erection of ten houses. With regard to the work at Minworth, the engineer's proposals are to increase the capacity of the existing plant to ten million gallons per day, by small additions to the structure; and to provide a duplicate unit of a capacity of ten million gallons per day.

Birmingham Record Consumption of Electricity.

The consumption of electricity in Birmingham last year constituted a record, the total sales showing a previously unsurpassed increase of 46¼ million units, and a total of 281 million units. This is an increase of nearly 20 per cent. on the sales for the previous year. The number of consumers of electricity increased during the year by 9753, and the total of users has more than doubled during the past three years.

West Midland Municipal Engineers.

More than a hundred delegates from all parts of the West Midlands district attended the annual meeting of the Institution of Municipal and County Engineers, held at Stafford on Saturday last. A welcome was extended to them by the Mayor (Alderman W. T. Richardson). Mr. Edward Willis (President) was in the chair, and a paper on "Municipal Work in Stafford," was read by Mr. W. Plant, borough engineer and surveyor. The delegates were the guests of the Mayor and Corporation at luncheon, and in the afternoon they inspected the Lammascote Farm where the activated sludge works were seen in operation—the various housing estates, the new works of the British Reinforced Concrete Company, and the waterworks at Milford.

Cannock Chase Coalfield.

During March there was a loss of 5·12d. per ton on all the coal raised in the Cannock Chase coalfield, and the accumulated deficit of the coalowners mounted by £38,850 to a total of £1,568,073. The wages of miners in the area this month are to continue at the same rate as for the past ten months—42 per cent. on the 1911 wage basis, though the ability of the industry to pay is only 16·38 per cent. Stallmen will receive a minimum wage of 9s. 4d. per shift.

Motor Vehicle Orders.

The Hastings Corporation has just placed with Guy Motors, Ltd., of Wolverhampton, a repeat order for twenty six-wheeled single-deck trolley omnibuses, and the Northampton Corporation has ordered two six-wheeled double-deck trolley omnibuses from the same firm.

Unemployment.

A further reduction of 7255 in the number of unemployed persons in the Midlands area brings the total down to 132,590, which, everything considered, is evidence of fairly satisfactory conditions existing in the works and factories in this area.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

The "Underground" Scheme.

FULLER information bearing on the underground railway scheme for Manchester, proposed by Mr. Henry Mattinson, the general manager and chief engineer of the Manchester Corporation tramways, is given in a report issued here this week. It is pointed out that the traffic on the suburban railways in and out of the main stations in Manchester averages 200,000 people a day. To deal with it, Mr. Mattinson proposes:—(1) To arrange with the various railway companies for the electrification forthwith of suburban railways for a distance to be agreed; (2) to connect by a small underground system of two routes all the suburban lines to one common centre; (3) to adjust the tramway and omnibus systems, where necessary, to fit in and co-ordinate with the operation of the electrified suburban railways. The length of underground routes required, it is stated, would not exceed 7 miles, whilst the extension of the electrified railways beyond and on the surface is practically limitless, and may be adapted from time to time as required or constructed if required at a far cheaper rate than would be entailed in the case of an ordinary underground railway system. It is suggested that the underground system should be constructed by the Corporation and leased to the railway companies for operation on terms at least recouping the interest and sinking fund charges on the expenditure.

Electricity Extensions.

The Manchester City Council this week sanctioned an application by the Electricity Department to the Ministry of Health for permission to borrow the sum of £101,500 to meet the Committee's requirements in the near future for the transmission, transformation and distribution of electricity. It is estimated that of the sum mentioned £50,000 is required for service mains, £10,000 for the erection of a transformer station at West Didsbury, and £15,000 for one at Failsworth, and £26,500 for high-tension mains. The City Council also approved of an application for permission to borrow an additional £25,000 for street lighting extensions. The Electricity Committee reports that in the return issued by the Electricity Commissioners for the year ended March 31st, 1927, relating to economy in fuel consumption, the Barton power station of the Manchester Corporation was again placed first.

Waterless Gasholders.

A deputation of the Gas Committee of the Manchester Corporation has just returned from Germany after an investigation of the new waterless gasholders, which, it is understood, may be adopted here in place of the existing holders. One of the deputation stated that all the members were favourably impressed with the new holder, and it is expected that in due course a report in favour of its adoption will be presented to the City Council. A Manchester firm of engineers is said to be putting down plant for the manufacture of these holders.

Export Credits Guarantees.

Mr. S. Judson, of the Export Credits Guarantee Department of the Department of Overseas Trade, has been appointed Manchester representative of the Department. Mr. Judson took up his duties on Tuesday of this week, and is temporarily housed in the Manchester Chamber of Commerce. The appointment of a local representative was decided upon as a result of the great increase in the volume of business which the Export Credits Departments is insuring for Lancashire exporters of textiles and engineering products.

Manchester University.

The Council of the Manchester University has accepted the resignation of Mr. Edward Sanderman, M.Sc., M. Inst. C.E., Associate Professor of Engineering.

Non-ferrous Metals.

The past week has witnessed a loss in every section of the non-ferrous metals market, with tin, as is usually the case, the worst sufferer in this respect, the decline in the other metals not being of any great moment. With regard to tin, buying conditions generally have shown a certain amount of improvement of late, and where consumers' order books have justified that course, there has been a fair weight of forward business done at the prices lately ruling. The statistical position, however, in this section of the market seems to be far from clear, and the decline on balance compared with a week ago is due probably to an increase in the stocks of the metal in this country. The fall in price was accelerated during the opening sessions of the market this week. The demand for copper has been on very moderate lines, but, although there has been a slight shading in the case of standard brands, the loss on the week has been no more than about 2s. 6d. a ton. Buying interest in both spelter and lead has been by no means active, and with ample supplies on offer there has been a loss in values in each case, though current quotations are still higher than they were a fortnight ago.

Iron.

Developments in the pig iron market locally, or rather the absence of developments, has been disappointing. Contrary to expectations, there has been very little interest shown in forward positions, and whilst deliveries against existing contracts are not altogether unsatisfactory much the larger proportion of the limited business that has been done this week has been on early delivery account. In spite of the strong resistance which Midland producers of foundry irons have put forward during the past month or two to further price concessions, they have been compelled to give way a little, and buyers are now able to secure supplies of the metal at 6d. to 1s. a ton cheaper than a week ago. For delivery Manchester or equal, for instance, Staffordshire iron is now quoted at 71s. per ton and Derbyshire at from 71s. 6d. to 72s., according to quantity. There has been no change in Middlesbrough brands, however, which are still at 79s. per ton delivered, nor in Scotch iron at from 87s. 6d. to 90s. Hematite has eased off a little, offers this week for delivery into this area being at about 83s. 6d. per ton. Lancashire bar iron remains a very quiet trade, though prices are unchanged at £10 per ton for Crown quality and £9 10s. for seconds.

Steel.

The outstanding feature of the steel market is the marked absence of forward buying interest, although some rollers report a fairly satisfactory trade in the aggregate, this being made up of comparatively small parcels for prompt or early delivery. Unless, however, there is an improvement in constructional engineering, so far as future prospects are concerned, there is likely before long to be a falling off from this direction in the demand for steel. With the exception of small steel bars, re-rolled from imported semi-finished products, values keep fairly steady all round. Ship and tank plates are at £8 12s. 6d. per ton, sections at £7 17s. 6d., boiler plates at £9 15s. to £10, and large diameter bars at £8 17s. 6d. Small re-rolled bars are the subject of keen competition, and supplies of these are obtainable at anything from £7 7s. 6d. to £7 12s. 6d. per ton. Trade in imported steel discloses few features of importance, and most sellers on this market report continued quiet conditions. In some respects, however, quotations are steadier than they were at the time of my last report, with billets at £5 5s., sheet bars at £5 7s. 6d. to £5 8s. 6d., bars at £6 6s., Thomas plates at £7 4s. to £7 5s., wire rods at £6 12s. 6d., and sections at from £5 16s. to £5 17s. 6d. per ton, for cash against shipping documents and including delivery to consumers' works in the Lancashire area.

BARROW-IN-FURNESS.

Hematite.

There is a movement in the West Coast hematite-producing district which may or may not be a sign of better things to come. On the one hand, the North Lonsdale Ironworks has put in two furnaces, which means that its stocks have at last been practically cleared, and that it has confidence in the future. There is no information forthcoming yet as to when Cleator Moor will start producing again. As a setback the Millom Company has put out a furnace, and has now only two in blast. Millom did a surprising thing some months ago. When other works, owing to accumulation of stocks, stopped production, the South Cumberland firm added its third furnace, and it has continued to turn out iron up to last week. Increasing stocks forced the company to reduce production. There is a slightly better feeling in the neighbourhood, but up to the present there are no remarkable orders being booked. Scotch business has improved with some producers, but trade with the Midlands remains the same. The demand for iron ore has slightly improved, and this improvement will be maintained, as regards both native and foreign ores. The steel market is dull, and there is not much being turned out in the whole district. Workington was only engaged on rolling railway sleepers last week. There is not a very bright outlook for steel makers at present, except in hoops, which are experiencing a steady demand.

SHEFFIELD.

(From our own Correspondent.)

Steel Trade Conditions.

THE various branches of the steel trade continue, in the aggregate, to provide more employment than was the case in pre-war years, but, owing to their greatly increased capacity, they are not by any means fully engaged, and there does not appear to be much sign of progress at present. The figures of unemployment have remained almost stationary since the resumption after the Easter holidays, but the position is less favourable than it was in March. The *Journal* of the Sheffield Chamber of Commerce mentions that the output of steel in the area is touching 100,000 tons a month, but that, while this is well above the highest pre-war rates, it is below the increased productive capacity. "The outlook for structural steel," says the *Journal*, "is good, that for railway steel moderate to good, but shipbuilding steel is a questionable proposition." The call for open-hearth steel is on an unsatisfactory level. The number of furnaces in commission remains stationary, and producers state that they find it difficult to keep them going. Business in the iron and steel market is quiet, and is largely of the hand-to-mouth order. There has recently been a decline in the home railway companies' specifications for axles, tires, and springs. The automobile industry continues to call for a large volume of steel and parts, but its requirements are still below the standard of the past few years.

Effect of the Budget.

Probably no industrial centre in the country will welcome the rating proposals of the Budget more than Sheffield. There are those who would rather have seen this city, and some other places, dealt with direct as necessitous areas, but still the Government's scheme of relieving the productive industries of three-quarters of the local rate burdens will be of very valuable assistance. Complaints of the heavy burden of these rates, and the substantial additions which they mean to the cost of steel production, have been common in chairmen's mouths for years past. Their magnitude was recently brought out in a striking way by Sir Herbert Lawrence, chairman of Vickers Ltd., at the annual meeting of the company, when he pointed out that the company's contribution to local rates, in Sheffield alone, last year was no less than £56,669. The first chairman to refer to the matter since the introduction of the Budget was Mr. W. L. Hichens, of Cammell Laird and Co., Ltd., who, speaking this week, said that in his view no wiser form of Government assistance could have been devised than the proposals of the Chancellor, and only regretted that apparently they would not become operative before October, 1929. At the same time, he pointed out that, while the relief of local rates would be of material assistance, it would not solve all their difficulties. The root trouble against which they had to contend was excessive competition, both at home and abroad, which in the case of the steel industry and shipbuilding had reduced prices below the economic level.

An Improved Year.

A substantial improvement in results is shown by the annual report of Sanderson Brothers and Newbould, Ltd., a very old Sheffield firm, who are makers of files, saws, edge tools, machine knives, &c. The report for 1927 shows a profit of £24,747, as against a loss of £11,942 for 1926, when the coal strike had a disastrous effect. The company is able to pay this year a dividend of 2½ per cent., less tax. Mr. Peter MacGregor, presiding at the annual meeting, remarked that the company seemed to be once more on the road to prosperity. The turnover last year was the best since 1920, and he considered that prospects were encouraging.

A New Industry.

A new addition to the industries of Sheffield is the manufacture of domestic mangles, a plant for which has been installed in a workshop at what was an aerodrome during the war. For a long period the home of the trade has been at Keighley, and it has also been carried on at one or two places in Lancashire. It has been introduced into Sheffield by the Yorkshire Manufacturing Company, Ltd., which is making all the standard types of mangles.

The Lighter Trades.

The home trade in garden and farming knives, shears, blades, &c., has not been as brisk as is usual at this time of the year, but there is a good deal of activity on export account. Only a moderate amount is being done in forest and sawmill tools. Shortage of work is reported at nearly all the light foundries. In engineering iron castings the position is better, but at the same time it is very uneven. The cutlery and plate trades are enjoying some increase of activity. While considerable slackness still exists, especially among firms catering for the ordinary shopkeeping trade, orders are now beginning to come in from the holiday resorts, and the production of hotel supplies is also providing a certain amount of work. Several large contracts for the Colonies are afoot, but those who have the placing of them are insisting upon extremely low prices. The increasing extent to which the Colonies are calling for the cheaper classes of goods is a cause of concern in the trade, as houses of repute have a standard of quality below which it is not their practice to go.

Colliery Development.

The Thoresby Colliery, which is being sunk by the Bolsover Colliery Company, near Edwinstowe, in Sherwood Forest, progressed another stage last week, when the top hard seam was struck at a depth of 580 yards. The coal is declared to be entirely satisfactory as regards both thickness and general quality. It was only as recently as February that the High Hazel seam was reached, and it was then thought that the top hard might be struck at 530 yards, but it has been necessary to go 50 yards further for it. Further sinking has yet to be done, and the colliery will not be in a real working condition for some time yet. It is hoped that it will eventually provide employment for 2500 men and boys. The colliery is of special interest, as it is to be a smokeless one. Everything will be done by electricity, which will be supplied from the other pits of the Bolsover Company at Bolsover, Cresswell, Mansfield, Rufford, and Clipstone. The supply will be sent by overhead lines to Edwinstowe at a pressure of 22,000 volts, and will be transformed at the colliery to 2200 volts and 500 volts direct-current. The company has already supplied electric light to the old village of Edwinstowe, and it is intended that its houses in the new model village shall also be lit by electricity.

Some Contracts.

It is reported that the Staveley Coal and Iron Company, Ltd., has secured a contract from the Admiralty for the supply of pig iron, and also a number of important orders for cast iron pipes, including one for 1000 tons for the Mid-Glamorgan Water Board. The Water Committee of Sheffield City Council has accepted the tender of the Stanton Ironworks Company to supply piping to the new works at Ewden Valley, at a price of £12,857. International Combustion, Ltd., of London, has recently secured orders totalling nearly a million sterling, from South Africa, the Hague, Shanghai, and England. The contracts will be executed at Derby, and will give employment to 800 workpeople for eighteen months.

NORTH OF ENGLAND.

(From our own Correspondent.)

Iron and Steel Exports.

THE volume of Cleveland's export trade in iron and steel still remains substantially below the modest standard of 1927. The small imports of material now being received from abroad indicate that producers have largely resumed control of the home market, but whilst British prices in this country appear to be on a competitive level, our prices are too high to hold out any present hope of a recapture of foreign markets. There has, of late, been some small improvement in the pig iron shipments, but the exports of steel, which constitute the best index of Cleveland's prosperity, are on a diminishing scale. Thus, whilst in 1927 the average monthly shipments of manufactured iron and steel from the Tees reached 71,500 tons, the average for the four months of 1928 has been about 10,000 tons less. The total shipments of pig iron from the Tees last month reached 20,427 tons, which, although it represents only an advance of 109 tons, as compared with the March figures, is actually the best monthly total since June, 1926. That, however, is not due to any expansion in the foreign trade, which actually fell from 11,106 tons in March to 8053 tons in April. On the other hand, there has been a further improvement in the deliveries to Scotland and South Wales, and it is this improvement which has sustained the total shipments of pig iron at approximately the same figure as that recorded for March. From a total of 66,870 tons in February the exports of manufactured iron and steel from the Tees declined to 62,257 tons in March, and 61,374 tons in April. Decreases were recorded in the trade with India, Africa, Australia, and Japan, and the only substantial improvement was in the volume of trade with South America, which represents a great and growing market for Cleveland steel products.

Cleveland Iron Trade.

The limited amount of Cleveland pig iron available for the open market is being absorbed without much difficulty, and stocks are very low. There is every indication that home trade will continue on steady lines, but an early material expansion of much-needed overseas demand does not appear likely. Disinclination of customers to commit themselves on forward account is as marked as ever. Prices are steady and firm, No. 1 Cleveland foundry iron being 68s. 6d.; No. 3 G.M.B., 66s.; No. 4 foundry, 65s.; and No. 4 forge, 64s. 6d.

Manufactured Iron and Steel.

The various branches of the manufactured iron and steel trade present few new features. Output is large, but early improvement in demand for several descriptions of material is essential to enable producers to maintain machinery in its present state of activity. Quotations are unchanged.

Hematite Pig Iron.

The production of East Coast hematite pig iron is now greatly restricted. Two blast-furnaces producing this iron were recently put out of commission, and a third is to be changed to the production of Cleveland pig iron. Some makers are taking a firm stand. Quotations vary a good deal, and while nominally mixed numbers are still put at 70s., orders can be placed on lower terms. On the other hand, there are named brands that command a trifle above that figure. With mixed numbers only 4s. above No. 3 Cleveland, hematite is comparatively cheap, the normal difference being 8s. to 10s.

Ironmaking Materials.

Business in the foreign ore trade keeps within narrow limits, but sellers maintain the quotation for best Rubio at 22s. 6d. c.i.f. Tees. The strike of ore miners in Sweden, reported last week to have been terminated, actually is dragging on, and further negotiations between the disputants are not anticipated before the middle of the month. Continental manufacturers are experiencing increasing difficulty in obtaining supplies of ore for their furnaces, owing to their substantial dependency on that source. With this and the unfavourable factors for the continental producers, the situation is tending to yield some temporary advantage to British manufacturers, who are well placed in regard to ore for current needs.

Coal-mining Depression.

There is no improvement in the economic position of the coal-mining industry in County Durham. On the contrary, it tends to become worse. This is revealed in the accountants' ascertainment which covers the proceeds and costs in March, and would regulate wages in May, but for the operation of the minimum clause under the county agreement. The report shows that the percentage on basis wages would be 28·82, but as the revised minimum is 65 per cent. on the basis, wages will be unchanged in the current month. The period covered by the ascertainment is the first since Sir William Plender, the independent chairman, gave his award, which reduced the county percentage from 89 to 65. It will thus be seen that, although he lowered the percentage by 24 points, the economic yield from the industry is still incapable of meeting anything like the present minimum of basis wages. In April, the accountants' report showed a percentage of 42·39 on the basis, and therefore the reduction between the present ascertainment and the previous one is 13·57 per cent. With the revised minimum at 65 per cent., and the economic yield at 28·82 per cent., the owners this month have to make up a deficiency of 36·18 per cent.

The Coal Trade.

Whilst new business in the Northern coal trade is maturing slowly, the inquiry continues active, and the general view is that the demand this month will show some expansion, and consequently operators are not forcing the market. The foreign consumer is finding it useless to endeavour to force any lower prices, and as a result counter offers come back at only slightly below the values offered. There is considerable anxiety developing as to the situation in the German coalfields, as, should a stoppage take place, it would have considerable influence on prices in this district, especially for early delivery. Foreign advices generally indicate that there will be no actual stoppage, but the uncertainty prevents forward operations. In the meantime, Northern collieries have good bookings over the next four weeks, and more business may quickly come on when the German mining position becomes clearer. There are many pits closed in Durham and a number in Northumberland, but those that are working manage to put in almost full time. For all May best Northumberland steams are quoted at 13s. 6d., and through second hands only odd fractional discounts are obtainable. Tyne primes and similar grades hold to 12s., while steam smalls are firm at 8s. 3d. to 8s. 9d. On the Durham side the gas coal position is good for early loading. Stocks are limited and prices are firmly maintained at 15s. to 15s. 3d. for best qualities and 13s. 6d. to 13s. 9d. for secondary sorts. The bunker trade keeps on steady lines; best and special qualities are scarce at 14s. to 15s., and secondary grades in moderately good supply at 13s. 6d. Supplies of all descriptions of coke are becoming plentiful, and export demand has taken a slow turn. Makers, however, hold steadily against concessions.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding.

THE output from Clyde shipyards during April was below the average. During the month twenty-eight vessels of 28,374 tons aggregate were launched. The return for this year to date amounting to fifty-nine vessels of 191,271 tons, is above the average, having been exceeded on only three occasions during the past twenty-five years, excluding the war years. The outlook can hardly be termed satisfactory, as the rate of output is still considerably greater than the rate of bookings of new contracts. Owners are looking for reduced costs of new tonnage, but there seems little possibility of such relief for some time to come at least. Rating reliefs under the Budget may be offset by increases in wages, which, it is thought, will be the probable outcome of present negotiations between employers and engineering unions. It is anticipated, at least, that plain time workers in shipyards will receive a special bonus of 3s. per week. If such is the case, it is computed that the increase in costs will be greater than the reduction under the rating proposals would amount to. Consequently, there seems to be small hope of an acceleration in the placing of orders for new tonnage. Fresh contracts reported during the month included a cargo steamer of 10,700 tons deadweight, and a number of small craft.

Steel.

Conditions in the steel trade are unchanged. Business on the whole remains quiet and few, if any, of the works are able to keep their plants fully occupied. The demand for heavy steel is disappointing, while sections are not a great deal better off, although one or two good contracts have been reported, one in particular being sufficient to warrant the reopening of an establishment in Lanarkshire. For the most part, however, steel-makers can only count on fairly steady employment for a few days ahead. Home prices are unchanged, while export rates are not tested to any extent.

Steel Sheets.

Sheet makers have a fair market for both black and galvanised descriptions, though the turnover in the former is largely confined to the lighter gauges.

Iron.

Keen competition from steel products and Belgian bars tends to keep home bar iron and re-rolled steel bar makers in a state of inactivity. Home prices are fixed at £10 5s. bar iron and £7 15s. re-rolled steel bars, but a good order for either for export could be placed below the current quotation of £9 15s. for bar iron and £7 per ton for re-rolled steel bars.

Pig Iron.

In the home market the turnover is very quiet and the export trade is restricted, but prices are maintained, owing to the enhanced costs of production. Shipments during the past week amounted to 175 tons.

Exports and Imports.

Imports at Glasgow during the past week included 5800 tons of iron ore, 2000 tons iron products, 2000 tons phosphates, and 1000 tons of steel plates. Exports included 8000 tons of iron and steel products.

Coal.

Conditions in the home and export coal markets are more or less unchanged. The reduction of outputs under the scheme to stabilise the industry is still going on, but supplies are still ample and collieries have difficulty in securing enhanced prices, unless perhaps in one or two isolated instances. With prospects of the market going further against them as production declines, exporters are doing nothing in the way of forward business, and shipping transactions are confined to small quantities, as the prices quoted are not sufficiently low to attract business on a liberal scale. Home demands are decreasing with the advancing season. Ell coals are fairly well booked, while best splints are fully booked up for this month. Fifeshire steams have a steady outlet, but Lothians steams remain dull. Washed materials are unsteady. Aggregate shipments during the past week amounted to 239,544 tons, against 216,728 tons in the preceding week and 272,883 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

ALTHOUGH it cannot be said that the conditions in the coal trade have appreciably improved, the position is certainly no worse. Unfortunately the demand is not equally distributed, and while some collieries are doing quite well so far as regularity of employment is concerned, others continue to be very short of orders and are losing a considerable amount of time. In scarcely any instance is a colliery working at a profit on the basis of current market prices. Still the undertone of the market for steam and anthracite coals is better, but in the steam section it is the superior grades which are coming in for more attention. Shipments of coal from this district last week were very satisfactory, inasmuch as the total came to 537,330 tons, as compared with 425,226 tons the previous week. It was pretty well known that good work was being done at the docks, but it was scarcely expected that the total would reach over the half million tons figure for the reason that during the second half of the week the supply of tonnage fell away to an appreciable extent. On Saturday last there was as many as thirty-six idle loading appliances at the various docks in this district, but as the result of arrivals over the week-end this week was started with the number of idle tips reduced to twenty-four. Although not many fresh orders have come along, the fact remains that exporters have a fair amount of business in hand, and they are finding it rather more difficult to secure the tonnage that is most suitable to their requirements. Large sized boats have become somewhat scarce, and, of course, it is very well known that owing to the unremunerative character of freights many owners have had temporarily to lay up their tonnage. The consequence is that rates of freight for the Mediterranean for tonnage, which can give early readiness, have moved up a little, and the market is steady to firm. No fresh big contract inquiries have come on the market, though news is expected by the end of this week regarding the order for 200,000 tons of steam coals for the Central Brazilian Railways, while as regards patent fuel the Algerian State Railways are reported to be in the market for 15,000 tons.

Coal Stabilisation Scheme.

Although there is no official information it is understood that the coal stabilisation scheme came into operation as from the 1st inst., but purely on a voluntary basis. Owing to the state of colliery finances, the proposed levy of 3d. per ton on production is suspended. A meeting of the Executive Committee of the South Wales Coal Marketing Association, held on Monday, decided to recommend collieries to adhere to agreed minimum prices. These minimum prices have been fixed for practically all classes of coal, and are in many cases below current market prices, but may be put up next week. The current range of minimum prices gives Admiralty large and ordinary Cardiff large, 17s. 3d. to 19s.; dry large, 17s. to 17s. 9d.; Monmouthshire large, 16s. to 17s. 6d.; and smalls, 10s. to 12s. 6d.

The Budget and Industry.

The proposal of the Chancellor of the Exchequer to afford relief to industry by rate reform has met with a mixed reception in South Wales. It is regarded with satisfaction in the steel and tin-plate trades, but in the coal industry there is disappointment. The main grievance is that no benefit can be felt for eighteen months, as the proposal does not operate until October, 1929. Immediate relief is a prime necessity of the coal trade. In a statement on the position Mr. Finlay Gibson, the secretary of the Coalowners' Association, points out that in the representations which the owners and workmen's representatives had made to the Prime Minister and subsequently to other ministers, they had emphasised that the loss on the working of the South Wales mining industry was at present at a rate of over £3,000,000 per annum, and it was under the pressure of this and other facts regarding the exhaustion of the colliery companies' financial resources that the industry claimed that whatever relief was to be granted should be immediate, and that the urgency of such relief to the export trade brooked no delay. So far as South Wales was concerned, the Chancellor's scheme would be virtually valueless as an expedient for the abatement of the severity of the present depression, for by October, 1929, either half the coalfield would be closed down or it would have overcome its difficulties and be again on the road to prosperity, and in view of either of these contingencies a scheme which did not bring any relief for eighteen months was useless. Still there is hope that following upon the interview which members of Parliament for Welsh constituencies had with the Prime Minister last week, something will yet be done by the Government to afford immediate assistance to the coal industry.

Great Western Railway Concessions.

Useful concessions have been made by the Great Western Railway Company in respect of non-statutory charges for services rendered at South Wales docks to operate as from the 1st inst. These concessions, which will aid trade, have come as the result of the representations made by the Cardiff Chamber of Commerce, and in all cases practically they mean a return to the pre-war level. Charges in respect of mixing coal have been reduced. In the case of single wagons the charge is now 2d. per ton instead of 3d., and the scale works up to lots of eight wagons at ¼d. per ton, as against ½d. per ton. No charge is now made for lots exceeding eight wagons. Haulage charges on dock lines are also reduced, and apply to general traffic as well as coal and coke. In one or two instances no charge is involved at all, whereas, formerly, a substantial rate operated. The action of the Great Western Railway Company is greatly appreciated by the commercial community.

Tin-plate Trade.

The conditions in the tin-plate trade are firm and the inquiry is good. Some works have sold practically the whole of their output up to early October.

Current Business.

The inquiry for coals for early shipment continues on a fair scale, but it is mainly for Admiralty qualities and for leading Monmouthshire grades. Inferior coals and dry descriptions are still quiet. Admiralty coals are very steady, and in a few instances salesmen are endeavouring to raise prices 3d. per ton. Sized coals and duffs are firm and scarce in supply, but smalls are somewhat irregular. At late prices coke and patent fuel move off steadily. Pitwood is a steady market, though the demand is rather quiet.

LARGE STEAM WINDING ENGINES.—With reference to the large steam winding engines which were illustrated and described in our issue of April 27th, we are asked by their builders, Markham and Co., Ltd., of Chesterfield, to say that, while one of the engines is for the Randfontein Estates and Gold Mining Company, the other is for the New State Areas, Ltd., and that both are not, therefore, for the first-named mining company, as stated in our article.

BRITISH WATERWORKS ASSOCIATION.

THE summer meeting of the British Waterworks Association will be held at Manchester, from July 4th to 7th next. The following is the order of proceedings:—On the morning of Wednesday, July 4th, at 11 o'clock, there will be a meeting of the Executive Committee in the Town Hall. In the afternoon, at 2.15 p.m., the seventeenth annual general meeting and conference will be opened in the Large Hall of the Town Hall, when the members will be welcomed by the Lord Mayor. After the transaction of the customary business, the incoming President will be installed and will deliver an address. Then will follow the reading and discussion of a paper on "Waterworks and their Financial Relations with the Community," by Mr. M. H. Munro, accountant, Manchester Corporation Waterworks Committee. At 7 p.m. there will be a reception at the Midland Hotel, by the President, chairman of Manchester Waterworks Committee; and at 7.30 p.m., the annual dinner will be held at the Midland Hotel.

On the Thursday morning, at 10 a.m., the following papers will be read and discussed, "The Underground Distribution and Thickness of the Secondary Formations in England, with Special Reference to the Sources of Subterranean Water," by Mr. Edgar Morton, Lecturer in Engineering Geology, University of Manchester"; and "The Heaton Park Service Reservoir," by Mr. S. Hall, A.M. Inst. C.E., resident engineer. In the afternoon visits will be paid to the Lostock Booster Station and the Heaton Park Reservoir; and in the evening at 7.30 p.m. the Lord Mayor will hold a reception at the Town Hall.

On the Friday there will be an all-day visit to the Haweswater works, a start being made from Victoria Station by special train at 9 a.m.

LAUNCHES AND TRIAL TRIPS.

BINTA, single-screw oil tanker; built by Sir W. G. Armstrong, Whitworth and Co., Ltd., to the order of Mr. Per Gjerding, of Bergen, Norway; dimensions, 408ft. by 55ft. 1in.; to carry 8200 tons deadweight on a mean draught of 25ft. Engines, one single-acting, two-cycle, six-cylinder, direct reversing Diesel engine; trial trip, April 20th.

NIEUW-HOLLAND, twin-screw mail steamer; built by Nederlandsche Scheepsbouw Maatschappij, of Amsterdam, to the order of Koninklyke Paketvaart Maatschappij; dimensions, 540ft. by 62ft. 9in. by 32ft. 4in.; 10,903 gross tonnage. Engines, turbine installation developing 8000 B.H.P. to get a speed of 15 knots; constructed by Maschinefabrik Gebrs Stork and Co., Hengelo, Holland; successful trial trip, April 20th.

CLYDEFIELD, single-screw oil tanker; built by D. and W. Henderson and Co., Ltd., to the order of Messrs. Hunting and Son, Newcastle-on-Tyne; dimensions, 420ft. by 57ft. 9in. by 32ft. 9in.; 7000 gross tonnage, 9500 deadweight tons; to carry oil in bulk. Engines, Harland-B. and W. eight-cylinder four-stroke Diesel engine; constructed by Harland and Wolff, Ltd.; launch, April 23rd.

PUNTA GORDA, shallow-draught oil tanker; built by Harland and Wolff, Ltd., to the order of Messrs. Andrew Weir and Co., for the Lago Shipping Company; dimensions, 315ft. by 50ft. Engines, twin-screw triple-expansion, pressure 180 lb. per square inch; launch, April 23rd.

WATERTON, cargo lake steamer; built by Sir W. G. Armstrong, Whitworth and Co., Ltd., to the order of Mathews Steamship Company, Ltd., Canada; dimensions, 259ft. 6in. by 43ft. 6in. by 21ft. 6in.; to carry 2350 tons on a 14ft. draught. Engines, triple-expansion, 17in., 28in., 46in. by 36in. stroke, pressure 200 lb. per square inch; constructed by the builders; launch, April 23rd.

INSTITUTION OF ENGINEERS-IN-CHARGE.—On Friday, April 27th, the Institution of Engineers-in-Charge held its twenty-eighth annual dinner at the Holborn Restaurant, with Mr. Loughnan Pendred, President, in the chair. The attendance, which reached nearly two hundred and fifty members and guests, was the largest in the history of the Institution. The first toast was proposed by Mr. Richard Allen, President of the Institution of Mechanical Engineers. It was that of "The Institution of Engineers-in-Charge," and in the course of it Mr. Allen touched upon the advantages which were to be gained by a closer understanding between the engineering societies. The toast was acknowledged by Mr. Pendred. Mr. H. G. Burford (Vice-President) then proposed "Industrial Research," and Sir Frank Heath responded in a speech of the greatest interest. Having retired from the position of secretary to the Department of Scientific and Industrial Research, he spoke, he said, as a free-lance, and he then proceeded to give his views upon public research, which he held should be directed to a definite useful end, and showed by a few striking examples the great savings which had already been effected by the work of the Research Associations. The toast of "The Guests" was proposed by Mr. S. Carter (vice-chairman), and was acknowledged in his usual amusing vein by Dr. Ormandy. The final toast on the list was that of "The President," which was given in very eloquent terms by Mr. Henry King, Chairman, but Mr. Patchell, in a few words, called upon the company to drink the health of the hon. secretary, Captain A. E. Penn, which was done with acclamation. An excellent programme of music, arranged by Mr. Will Dawe, formed a feature of a very pleasant evening.

ROYAL INSTITUTION.—The annual meeting of the members of the Royal Institution was held on Tuesday afternoon (May 1st), Dr. Mitchell Bruce, Vice-President, in the chair. The annual report of the Committee of Visitors for the year 1927, testifying to the continued prosperity and efficient management of the Institution, was read and adopted. The report of the Davy Faraday Research Laboratory Committee was also read. Seventy-five new members were elected in 1927, and sixty-three lectures and nineteen evening discourses were delivered. The books and pamphlets presented amounted to about 181 volumes, making, with the 581 volumes—including periodicals bound—purchased by the managers, a total of 762 volumes added to the library in the year. Thanks were voted to the President, treasurer and secretary; to the Committees of Managers and Visitors, and to the professors, for their valuable services to the Institution during the past year. The following gentlemen were unanimously elected as officers for the ensuing year:—President, The Duke of Northumberland; treasurer, Sir Arthur Keith; secretary, Sir Robert Robertson; managers, The Right Hon. Lord Blanesburgh, Sir James Crichton-Browne, J. Mitchell Bruce, Alfred Carpmael, Frederick G. Donnan, Sir James Dundas-Grant, Viscount Falmouth, Sir Robert Hadfield, John S. Highfield, W. E. Lawson Johnston, Colonel Sir Henry Lyons, Charles H. Mers, Saxton W. Armstrong Noble, Sir Richard Paget, and George C. Simpson; visitors, Edward N. da C. Andrade, Alexander Glegg, Commander A. C. Goolden, W. Vaux Graham, Kenneth Robert Hay, Sir Lawrence Jones, Vincent Warren Low, William Macnab, Emile S. Mond, Wyndham A. Milligan, Clifford C. Paterson, Edwin H. Rayner, Hugh Munro Ross, Sidney Skinner, and William J. Tennant.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	19/- to 21/-
(1) Spanish	19/- to 21/-
(1) N. African	19/- to 21/-
N.E. Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	22/6

PIG IRON.

	Home. £ s. d	Export. £ s. d.
(2) Scotland—		
Hematite	3 14 6	—
No. 1 Foundry	3 15 0 to 3 16 0	—
No. 3 Foundry	3 10 0 to 3 11 0	—
N.E. Coast—		
Hematite Mixed Nos.	3 10 0	3 10 0
No. 1	3 10 6	3 10 6
Cleveland—		
No. 1	3 8 6	3 8 6
Silicious Iron	3 8 6	3 8 6
No. 3 G.M.B.	3 6 0	3 6 0
No. 4 Foundry	3 5 0	3 5 0
No. 4 Forge	3 4 6	3 4 6
Mottled	3 4 0	3 4 0
White	3 4 0	3 4 0
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
,, ,, Foundry	3 3 6	—
(3) Northampton—		
Foundry No. 3	2 18 6 to 3 0 0	—
Forge	2 13 6	—
(3) Derbyshire—		
No. 3 Foundry	3 3 6 to 3 4 6	—
Forge	2 19 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 3 6	—
No. 4 Forge	3 1 0	—
Basic	3 0 0	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 2 0 (a); 4 5 0 (b); 4 8 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d	Export. £ s. d
Scotland—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 5 0	—
Common Bars	10 5 0	—
Best Bars	10 15 0	—
Lancs.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	13 0 0	—
S. Yorks.—		
Crown Bars	10 10 0	—
Best Bars	11 0 0	—
Hoops	12 0 0	—
Midlands—		
Crown Bars	9 5 0 to 10 0 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 17 6 to 9 0 0	—
Gas Tube Strip	11 0 0	—

STEEL. (d)

	(6) Home. £ s. d	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ½in. and up	8 7 6	7 12 6
Sections	7 17 6	7 2 6
Steel Sheets, ¼in.	8 12 6	8 10 0
Sheets (Gal. Cor. 24 B.G.)	13 5 0	13 5 0

STEEL (*continued*).

	Home. £ s. d	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 7 6	—
Angles	7 17 6	—
Boiler Plates	12 15 0	—
Joists	7 17 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	7 12 6	—
Soft Billets	6 15 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	7 10 0 to 10 0 0	—
Manchester—		
Bars (Round)	8 17 6	—
,, (Small Round)	7 12 6	—
Hoops (Baling)	10 5 0	10 0 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 12 6	—
,, (Lancs. Boiler)	10 0 0	—
Sheffield—		
Siemens Acid Billets	10 0 0	—
Hard Basic	7 2 6 to 7 12 6	—
Intermediate Basic	7 0 0	—
Soft Basic	6 5 0	—
Hoops	9 10 0 to 10 10 0	—
Soft Wire Rods	7 10 0	—
Midlands—		
Small Rolled Bars	7 5 0 to 8 0 0	—
Billets and Sheet Bars	5 15 0 to 6 0 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 0 0 to 13 2 6	—
Angles	7 17 6	—
Joists	7 17 6	—
Tees	8 17 6	—
Bridge and Tank Plates	8 12 6	—
Boiler Plates	11 0 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	18/4½ to 18/6
Block Tin (cash)	229 15 0
,, (three months)	230 2 6
Copper (cash)	61 11 3
,, (three months)	61 16 3
Spanish Lead (cash)	20 6 3
,, (three months)	20 11 3
Spelter (cash)	25 16 3
,, (three months)	25 11 3
Manchester—	
Copper, Best Selected Ingots	65 15 0
,, Electrolytic	67 5 0
,, Strong Sheets	92 0 0
,, Tubes (Basis Price), lb.	0 1 1
Brass Tubes (Basis Price), lb.	0 0 11½
,, Condenser, lb.	0 1 2
Lead, English	22 5 0
,, Foreign	20 17 6
Spelter	26 2 6
Aluminium (per ton)	£107

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/7½ per lb.	
Ferro Tungsten	1/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£22 10 0	7/6
,, ,, 6 p.c. to 8 p.c. ,,	£22 2 6	7/-
,, ,, 8 p.c. to 10 p.c. ,,	£22 0 0	6/-
,, ,, Specially refined		
,, ,, Max. 2 p.c. carbon	£35 0 0	12/-
,, ,, ,, 1 p.c. carbon	£40 10 0	15/-
,, ,, ,, 0·70 p.c. carbon	£46 10 0	17/-
,, ,, ,, carbon free	1/2 per lb.	
Metallic Chromium	2/5 per lb.	
Ferro Manganese (per ton)	£13 10 0 for home; £13 10 0 for export	
,, Silicon, 45 p.c. to 50 p.c.	£13 0 0 scale 5/- per unit	
,, ,, 75 p.c.	£20 10 0 scale 6/- per unit	
,, Vanadium	14/3 per lb.	
,, Molybdenum	4/6 per lb.	
,, Titanium (carbon free)	1/1 per lb.	
Nickel (per ton)	£170 to £175	
Ferro-Cobalt	9/6 per lb.	

FUELS.

SCOTLAND.
(*Prices not stable.*)

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	13/9
,, ,, Ell	14/6
,, ,, Splint	16/3 to 17/-
,, ,, Trebles	13/3
,, ,, Doubles	12/3
,, ,, Singles	11/3
Ayrshire—	
(f.o.b. Ports)—Steam	13/-
,, ,, Jewel	15/6
,, ,, Trebles	12/9
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	10/6 to 13/-
Screened Navigation	18/-
Trebles	12/3
Doubles	12/3 to 12/6
Singles	11/3
Lothians—	
(f.o.b. Leith)—Best Steam	11/6 to 12/-
Secondary Steam	11/3
Trebles	12/3
Doubles	11/9 to 12/-
Singles	11/3

ENGLAND.

(8) N.W. Coast—	
Steams	24/- to 25/-
Household	37/6 to 50/-
Coke	22/6 to 23/6
Northumberland—	
Best Steams	13/6 to 14/-
Second Steams	11/9 to 12/-
Steam Smalls	9/- to 9/6
Unscreened	11/9 to 12/-
Household	21/- to 27/-
Durham—	
Best Gas	15/- to 15/3
Second	13/3 to 13/9
Household	21/- to 27/-
Foundry Coke	17/6 to 18/-
Sheffield—	Inland.
Best Hand-picked Branch	27/6 to 29/6 —
Derbyshire Best Bright House	20/6 to 21/6 —
Best House Coal	19/- to 20/6 —
Screened House Coal	16/- to 17/6 —
,, ,, Nuts	15/- to 16/- —
Yorkshire Hards	15/- to 16/- —
Derbyshire Hards	15/- to 16/- —
Rough Slacks	8/6 to 9/6 —
Nutty Slacks	6/- to 7/- —
Smalls	3/- to 4/6 —
Blast-furnace Coke (Inland)	13/- at ovens —
Furnace and Foundry Coke (Export), f.o.b.	16/9 to 17/6

(9) SOUTH WALES.

Cardiff— Steam Coals:	
Best Smokeless Large	19/3 to 19/9
Second Smokeless Large	18/6 to 19/-
Best Dry Large	18/- to 18/6
Ordinary Dry Large	17/6 to 18/-
Best Black Vein Large	17/3 to 17/9
Western Valley Large	16/9 to 17/3
Best Eastern Valley Large	16/6 to 17/3
Ordinary Eastern Valley Large	16/3 to 16/6
Best Steam Smalls	12/6 to 13/-
Ordinary Smalls	11/- to 12/6
Washed Nuts	18/- to 21/-
No. 3 Rhondda Large	19/6 to 20/-
,, ,, Smalls	14/- to 14/6
No. 2 ,, Large	16/- to 16/6
,, ,, Through	14/6 to 15/6
,, ,, Smalls	12/6 to 13/6
Foundry Coke (export)	30/- to 37/6
Furnace Coke (export)	27/6 to 30/-
Patent Fuel	21/6 to 22/6
Pitwood (ex ship)	27/3 to 27/6
Swansea— Anthracite Coals:	
Best Big Vein Large	32/- to 34/-
Seconds	24/6 to 27/6
Red Vein	20/6 to 27/-
Machine-made Cobbles	40/- to 42/6
Nuts	37/6 to 42/6
Beans	23/- to 27/-
Peas	17/9 to 19/-
Breaker Duff	8/- to 8/6
Rubbly Culm	10/- to 10/6
Steam Coals:	
Large	17/6 to 18/6
Seconds	16/- to 17/-
Smalls	10/- to 12/-
Cargo Through	15/- to 16/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire. (6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. ( ) Delivered Birmingham. (d) Rebate 12/6 joists and 10/- all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our own Correspondent in Paris.)

Mechanical Engineering.

THERE are complaints that the manufacturing industries are entering upon a difficult phase which may prove serious if production is to be burdened still further by charges due to the social legislation that has already been passed or is in preparation. It is stated that the situation is fairly well expressed by the returns of foreign trade, which for some time past have been showing a decrease in the exports of manufactured goods. The values of such goods have been receding much more rapidly than the quantities, and during the first three months of the year the quantities, as well as values, underwent a declension as compared with the first quarter of last year, the diminution of exports of manufactured goods being 28,423 tons and 534,745,000f. At the same time there was an increase of 3781 tons and 390,492,000f. in the imports of manufactured goods. It is probable that the expanding imports are due to the larger quantity of goods supplied by Germany on account of reparations, and the increasing values may certainly be attributed partly to the higher prices at which they are invoiced by the Germans. The French Government must accept the German terms if it is to get anything at all for reparations, and while the machinery and material supplied are mainly for the equipment of ports, hydro-electric power stations, railways and works and factories, the importation obviously only benefits the home manufacturing industries to the extent of providing a complement of the plant supplied by the Germans. It gives French makers more to do at home, but they are losing foreign trade through increasing production costs. It is felt that some arrangement must be come to between machinery and other makers and the iron and steel producers for a reduction of prices of raw material to be worked up for export, but as all attempts to obtain such relief have so far failed it does not seem likely that the steel *comptoirs* will make any concessions of this kind in the future.

Continuous Brakes.

While the problem of the continuous brake for goods trains appears to have been definitely settled by the selection of the Westinghouse and the Kunze-Knorr brakes there is nevertheless a good deal of manœuvring in some other countries to secure the adoption of the Norwegian Drolshammer brake, which has been tested for a considerable time, principally upon the Swiss railways, where the results are declared to have been so good that efforts were made recently at a meeting of commissions of the International Railway Union at Brussels to get it adopted under the same conditions as the two other brakes named. This is causing some annoyance to the French, who refuse to admit a reopening of the debate, which may delay still further the equipment of goods trains with continuous brakes. Everything is now ready for a simultaneous manufacture of the Westinghouse brake in France and Germany on condition of the Germans agreeing to supply the Westinghouse instead of the Kunze-Knorr, and although there is nothing to prevent other suitable interchangeable brakes from being adopted, the French affirm that, as the Drolshammer is based upon an entirely different system, it is doubtful whether it can be made entirely interchangeable, and in any case it is declared to be more complicated than the French and German brakes.

The Pyrenees Railways.

This month there will be put into service with great ceremony the first of the two railways which are to open up traffic between France and Spain through the Eastern Pyrenees. The line between Bedous and Jaca has been completed and the other between Aix-les-Thermes and Ripoll will be terminated next year. In 1914 the line from Pau to Orloron was extended to Bedous, and from that point the penetration of the Pyrenees began, the line steadily rising from an altitude of 400 m. along the Gave d'Aspe, which is crossed by three steel bridges and three viaducts. There are no fewer than fourteen tunnels between Bedous and the frontier, the most important being the Portalet, 940 m. long, the famous helicoidal tunnel of 1750 m., and finally the Somport tunnel, at an altitude of 1211 m., which is 8 kiloms. long, and of which 3500 m. are in France and 4500 m. in Spain. At the southern end of the Somport is the Canfranc international station, which is a very fine construction with a frontage of 300 m. As the Pyrenees are much deeper on the French side the gradients are often very heavy, in some cases as much as 43 mm. per metre, but on leaving the Canfranc station there is only a moderate down gradient for a distance of 25 kiloms. to Jaca, where the existing line to Saragossa is joined. The saving of distance is appreciable and is even considerable for towns like Pau and Toulouse, but the advantage of the railway is expected to lie more particularly in a development of traffic which is at present restricted by lack of transport facilities and also in a more active working of the mineral resources of the Pyrenees.

The Makhonine Fuel.

Since the failure of the Russian engineer, Monsieur Makhonine, to launch his apparatus which was to be fitted to heavy motor vehicles for producing spirit direct from heavy oils, he has turned his attention to a new fuel intended specially for aviation and marine engines. He claims that his fuel is uninflammable and is capable of much higher compressions than petrol, with the result that while being perfectly safe it gives a much wider range of action to aeroplanes for a given quantity of fuel. For a year past tests have been carried out in the navy, and some months ago the Minister of Marine announced that the tests had revealed serious defects in the fuel. Under pressure of a section of the Chamber of Deputies it was decided to continue the tests in the air service, and, apparently, the difficulties referred to have been overcome, for it is stated that the trials at Villacoublay have been entirely satisfactory. The engines ran from thirty-one to forty hours, but while the results are declared to be good they can hardly be accepted as conclusive in view of the failure of the heavy oil refining apparatus after it was officially stated to have come triumphantly through tests on military tractors and lorries.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

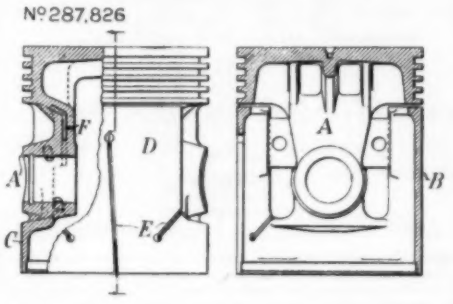
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

287,826. December 15th, 1927.—PISTONS, *E. C. R. Marks*, 57, *Lincoln's Inn-fields, London, W.C.* 2.

In this piston the gudgeon pin bearings are carried by "piers" A depending from the upper part of the piston. To the lower

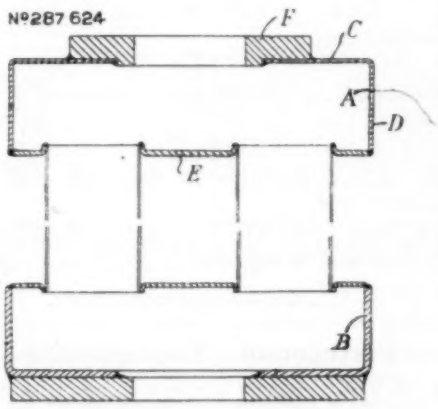


part of these piers there is attached a skirt B. This skirt is formed as an annular portion C and two tongues D. The tongues are split, as indicated at E, to make them slightly flexible. The piston is made of a light alloy and is braced by struts F of a stronger metal.—*March 29th*, 1928.

TRANSFORMERS AND CONVERTERS.

287,624. December 22nd, 1926.—IMPROVEMENTS IN AND RELATING TO RADIATORS, PARTICULARLY FOR ELECTRIC TRANSFORMER TANKS, The British Thomson-Houston Company, Ltd., at Crown House, Aldwych, London, W.C. 2, and Robert Dumas, of 27, Lillington-road, Leamington Spa, Rugby.

This specification describes a transformer radiator with upper and lower headers A and B, connected by tubes. The bottom

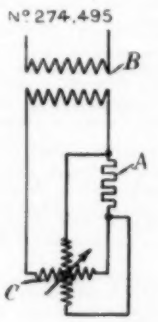


C and sides D of each header are bent or pressed up to box-shaped form from a single plate. The corners are arc welded, and each header is completed by a flat tube plate E, secured to the side of the header. The bottom plate C carries a flange F to which a flange on the upper pipe connection to the tank is secured.—*March 22nd*, 1928.

ELECTRICAL APPLIANCES.

274,495. July 15th, 1927.—IMPROVEMENTS IN AND RELATING TO OIL-IMMERSED TRANSFORMERS, Aktiengesellschaft Brown, Boveri et Cie., of Baden, Switzerland.

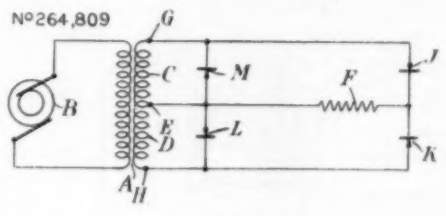
This specification describes a method of protecting oil transformers on the formation of an arc under the oil. At the part of the transformer box at which the gas generated by an arc



accumulates, a resistance A having a considerable temperature coefficient is provided and is continuously heated by any source of current B, such as an accumulator, or an auxiliary transformer having at least an approximately constant voltage. Normally this resistance is immersed in oil, the temperature of which is approximately constant, so that the quantity of heat given off by the resistance to the oil by conduction and circulation is not subjected to fluctuations of any appreciable magnitude, and the temperature of the heating element will remain normally constant. But on the latter being suddenly placed in contact with a gas atmosphere its temperature will momentarily rise. This will cause its electric resistance to change, and this change of resistance is measured by means of the ohmmeter C, which can be utilised for closing or opening an auxiliary circuit.—*March 22nd*, 1928.

264,809. December 23rd, 1926.—IMPROVEMENTS RELATING TO APPARATUS FOR RECTIFYING ALTERNATING CURRENTS, The Westinghouse Brake and Saxby Signal Company, Ltd., of 82, York-road, King's Cross, London, N. 1, Assignees of Donald Gearhart Ackerly, 47, Ella-street, Wilkinsburg, State of Pennsylvania.

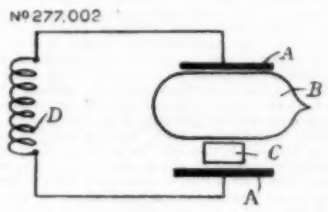
This invention relates to apparatus for rectifying alternating electric currents of the kind in which a rectifier offering unequal resistance to the flow of current in opposite directions is connected in series with the load to which rectified current is to be supplied, the invention having for its object to provide improved arrangements for reducing the voltage impressed upon the rectifier for the flow of current in the direction of higher resistance, thereby reducing this current and improving the rectifying action. In the diagram A is a transformer having its primary connected to an alternator B. The secondary is divided into two parts C and D by a mid-tap E. One terminal of the load F is connected with the mid-point, and the other terminal of the load is connected with terminals G and H through oppositely disposed rectifiers J and K. During one half of each cycle current is



supplied from the winding C through the load F and rectifier J. At the same time, however, a smaller current flows from the winding D through the load F and rectifier K in the opposite direction. This smaller current is undesirable because it reduces the useful or resultant current in the load, and a rectifier L is therefore connected across winding D to shunt this winding when the terminal G is positive with respect to terminal H so as to cause a potential drop in the secondary D and thus reduce the potential drop across the rectifier K. The current which would otherwise flow through the load and rectifier K in its high resistance direction is thereby considerably reduced and the useful power in the load F is correspondingly increased. For a similar reason a rectifier M is connected across the winding C to shunt this winding during the other half of each cycle when the terminal H is positive with respect to terminal G and current is being supplied to load through the rectifier J. It has been ascertained in practice that with the other portions of the apparatus unchanged, the useful power delivered to load F with rectifiers M and L connected as shown, is several times as great as the power supplied to the load with these rectifiers omitted.—*March 23rd*, 1928.

277,002. August 31st, 1927.—APPARATUS FOR MAKING VISIBLE PIEZO-ELECTRICAL RESONANCE OSCILLATIONS, Heinrich Eberhard, of 5, Niedstrasse, Berlin-Friedenau, Germany, and Radiofrequenz Gesellschaft mit beschränkter Haftung, of 5, Niedstrasse, Berlin-Friedenau.

Piezo-electrical resonance oscillations are made visible in accordance with this invention by means of a gas-filled or evacuated vessel. In the accompanying illustration electrodes are

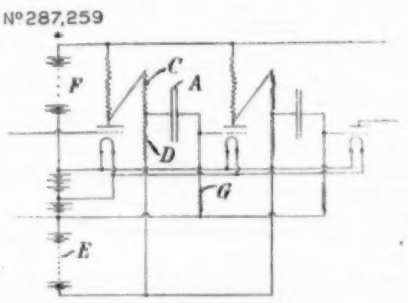


shown at A and a gas-filled vessel at B. The crystal is shown at C and the coil for coupling the apparatus to the oscillating electro-magneto field at D. As soon as the frequency of the electro-magnetic oscillations approaches the piezo-electrical natural frequency of the crystal C, the crystal shows a luminous effect. The luminous phenomena, the specification states, will occur if the vessel is filled with helium or other rare gas, such as argon.—*March 29th*, 1928.

TELEGRAPHS AND TELEPHONES.

287,259. January 5th, 1927.—IMPROVEMENTS IN AND RELATING TO THERMIONIC AMPLIFIERS, Harry Vernon Higgitt and the Eastern Telegraph Company, Ltd., both of Electra House, Moorgate, London, E.C. 2.

The object of the blocking condenser in resistance capacity amplifiers is, of course, to avoid the high potential of the anode



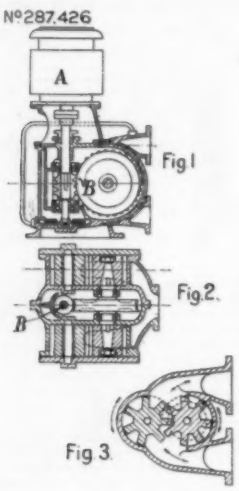
potential source being applied to the grid of the valve in the next stage, the difference of potential across the condenser constituting a large fraction of the potential of the anode potential source. When employing large condensers, as, for example, is generally done when amplifying telegraph signal currents, the leakage between the two sets of plates assumes objectionable

magnitude, and it is the object of this invention to eliminate or reduce as far as possible the potential difference across the coupling condensers. Instead of connecting the anode of the first valve direct to one set of condenser plates A, as is usual, the inventors provide a circuit from the anode to the cathode which comprises two high resistances C D—about 1 megohm each—and a high-tension battery E of the same order as the high-tension battery F, but connected with reversed polarity. A connection is made from the junction between the two last-mentioned resistances to one set of condenser plates A, the other set being connected to the grid of the next succeeding valve. The magnitude of the two resistances C D and the potentials of the two high-tension batteries F E are so selected that the potential of both sets of condenser plates A is substantially the same, the potential of the grid itself being, of course, determined by the grid bias potential tapping point acting through the grid leakage resistance G.—*March 22nd*, 1928.

PUMPING AND BLOWING MACHINERY.

287,426. November 9th, 1927.—GEAR PUMPS, Drysdale and Co., Ltd., Ferry-road, Yoker, Glasgow, and J. Young.

What this invention virtually boils down to is the embodiment of two toothed gear pumps in one casing, with the teeth of the two gears so set as to minimise the pulsations of delivery. The



two pumps are set side by side, as shown in the plan view, Fig. 2, and are driven by a common motor A—Fig. 1—and appropriate worm gearing B. The suction and delivery branches of the two pumps are connected together as shown in the plan view.—*March 22nd*, 1928.

METALLURGY.

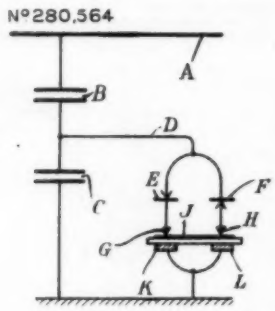
287,194. November 8th, 1926.—PROTECTION OF FERROUS METALS AGAINST CORROSION, *G. B. Ellis*, 70, *Chancery-lane, London, W.C. 2.*

This specification really requires no illustration, although a cut is included in the original. It is concerned with the protection of ferrous metals against corrosion by plating them with other metals resistant to corrosion. In his specification, the inventor says that he has demonstrated the success of his process, particularly with boiler tubes made of steel containing 0·15 to 0·20 per cent. carbon. The invention is of particular value, he says, in connection with tubes provided with longitudinal fins welded to them, which are in some cases arranged in the boiler furnace and exposed to the radiant heat of the burning fuel, so that they may be heated to an exceedingly high temperature, approaching 2500 deg. Fah. By treating such fins in accordance with his invention, their durability under such conditions is greatly increased. In essence, the process is to coat the article by means of electro-deposition, first with a film of nickel and then with a film of chromium. The whole is then subjected to a heat treatment at a temperature of from 1800 deg. to 2500 deg. Fah. for a period of about two hours.—*March 8th*, 1928.

MISCELLANEOUS.

280,564. November 10th, 1927.—APPARATUS FOR DELINEATING ELECTRIC PROCESSES, *Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemenstadt, Germany.*

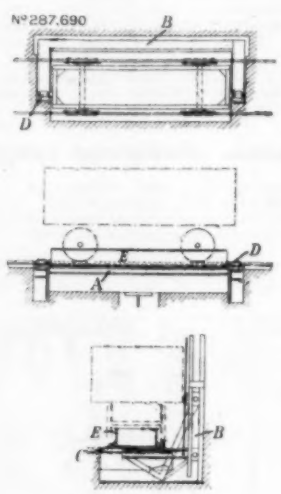
For recording electrical processes in lines or mains, this specification states, the action of electricity on a chemically variable layer is made to produce Lichtenberg figures which depend on the polarity of the process of discharge. In the case of quickly varying processes an overlapping of the drawings recording positive or negative processes may occur and render the picture unsuitable for use. For this reason, the specification goes on to state, it appears advisable to separate the positive and negative



drawings, and that is done by means of valves. To the line A under investigation a capacity voltage divider consisting of two condensers B and C is connected to earth, but an ohmic or inductive voltage divider could be used. The wire D between the two condensers goes to two thermionic valves E and F which act in different directions and are connected to electrodes G and H, which touch the chemical layer J. Opposite the electrodes G and H there are electrodes K and L which are electrically connected together and to earth. In this way overlapping of the drawings is prevented. There are two other illustrations.—*March 22nd*, 1928.

287,690. February 21st, 1927.—WEIGHING AND TIPPING RAILWAY WAGONS, Stothert and Pitt, Ltd., Newark Foundry, Bath, and C. W. Presland, Crowsnest, Durnsey Eyot, Shepperton.

This apparatus is for weighing and tipping railway wagons. It comprises a normal weighbridge table A, on to which the



wagon is run and weighed. Straddling the table there is an L-shaped frame B, which carries a cradle C by trunnions D D. This table bears two longitudinal girders E E, which pass beneath the wagon over the top of the weighbridge table. When the weighing is finished the cradle is raised, the girders E E engage the axles of the wagon and it is tipped sideways.—*March 29th*, 1928.

287,837. February 1st, 1928.—NUTS AND BOLTS, S. H. Sims, 10, Fore-street, London, and J. J. Boreham, 164, Richmond-road, Dalston.

The inventors propose to mill a slot down the length of a set-

screw or bolt, as shown in the illustration, and to fill it with compressed fibre, in order to prevent the nut slacking off on account of vibration.—*March 29th*, 1928.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

IRON AND STEEL INSTITUTE.—At the house of the Institution of Civil Engineers, Great George-street, London, S.W. 1. Annual meeting. For Programme see page 375.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. "The Application of Electricity to Domestic Purposes," by Mr. F. C. Dain. 7.30 p.m.

KEIGHLEY ASSOCIATION OF ENGINEERS.—Queen's Hotel, Keighley. Annual general meeting. 8 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, London, W. 1. Discourse, "Credit and Currency," by the Right Hon. Reginald McKenna. 9 p.m.

SATURDAY, MAY 5TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—College of Technology, Sackville-street, Manchester. "Modern Blast-furnace Practice," by Mr. R. Sharp. 4 p.m.

THE INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—North-Eastern District meeting at Thornaby-on-Tees.

MONDAY, MAY 7TH.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, London, W. 1. General meeting. 5 p.m.

SOCIETY OF ENGINEERS.—In the Apartments of the Geological Society, Burlington House, W. 1. "Technical Education in Relation to Industrial Development in India," by Mr. J. N. Hare Duke. 6 p.m.

SURVEYORS' INSTITUTION.—At the Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1. Discussion on the Report of the Royal Commission on Land Drainage in England and Wales. 8 p.m.

TUESDAY, MAY 8TH.

INSTITUTE OF MARINE ENGINEERS.—85–88, The Minories, Tower-hill, London, E. 1. "A Non-chemical Method for the Prevention of Scale Accumulation in Boilers, Diesel Jackets and Water Circulating Systems in General," by Mr. A. T. Ridout. 6.30 p.m.

THE INSTITUTE OF METALS.—The Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1. Eighteenth annual May lecture, "The Chemical Properties of Crystals," by Professor Cecil H. Desch. 8 p.m.

THE INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Annual general meeting of corporate members only, to receive the report of the Council and to elect the Council and auditors for the ensuing year. 6 p.m.

THE INSTITUTION OF PETROLEUM TECHNOLOGISTS.—At the House of the Royal Society of Arts, John-street, Adelphi, W.C. 2. "Experiments in Viscometry," by Messrs. H. S. Rowell and D. Finlayson. 5.30 p.m.

WEDNESDAY, MAY 9TH.

INSTITUTE OF FUEL.—Chemical Society's Rooms, Burlington House, Piccadilly, W. 1. "The Engineer in Industry," by Mr. A. J. T. Taylor. 6 p.m.

THURSDAY, MAY 10TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Meeting of the Derby Graduates at the Cavendish Café, Cornmarket, Derby. "Free Wheel Devices," by Mr. C. Mercy. 7.30 p.m.

ROYAL AERONAUTICAL SOCIETY.—At the House of the Royal Society of Arts, John-street, Adelphi, W.C. 2. "Design and Construction of Modern Rigid Airships," by Mr. B. N. Wallis. 6.30 p.m.

THURSDAY TO SATURDAY, MAY 10TH TO 12TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Irish District meeting to be held at Dublin.

FRIDAY, MAY 11TH.

ASSOCIATION OF ENGINEERING AND SHIPBUILDING DRAUGHTSMEN.—Chamber of Commerce, Room 7, Birmingham. "The Limits of Turbo-generator Design," by Mr. Wm. Sharp. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, Westminster, S.W. 1. "Notes on the Drying of Industrial Products," by Mr. A. T. Henly. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, W. 1. Discourse, "Life's Unsuspected Partnerships," by Miss Doris L. MacKinnon. 9 p.m.

UNIVERSITY OF LONDON, UNIVERSITY COLLEGE.—"The Value of Aviation to the British Empire," by The Right Hon. Sir Samuel Hoare. 5.30 p.m.

SATURDAY, MAY 12TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—South-Eastern District meeting to be held at New Malden, Surrey. 1.30 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—South-Western District meeting at Totnes.

TUESDAY, MAY 15TH.

ENGINEERING GOLFING SOCIETY.—The course of the Tandridge Golf Club near Oxted. Spring meeting. 10 a.m.

WEDNESDAY, MAY 16TH.

OVERHEAD LINES ASSOCIATION.—The Institution of Electrical Engineers. Mr. D. C. Redfern, Engineer, Lothians Electric Power Company, will open a discussion on "Standard Overhead Lines: Their Advantages and Number of Different Standards Required." 5.30 p.m.

ROYAL METAL TRADES PENSION AND BENEVOLENT SOCIETY.—Second annual golf competition at Sundridge Park Golf Club, Bromley, Kent.

THE FARADAY SOCIETY.—In the rooms of the Chemical Society Burlington House, Piccadilly, London, W. 1. Annual general meeting. Presidential address, "Diffusion in Solids," by Professor C. H. Desch. 8 p.m.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE UNIVERSAL SYSTEM OF MACHINE MOULDING AND MACHINERY COMPANY, Ltd., of 13–15, Wilson-street, London, E.C. 2, asks us to announce that it has recently been granted the exclusive selling rights for aluminium pressure die-casting machines—patent Nos. 203,399 and 204,743.

THE HOFFMANN MANUFACTURING COMPANY, Ltd., asks us to announce that, following upon the resignations of Messrs. Harvey du Cros, William du Cros, Herbert Guedalla, John H. Guy and J. Douglas Watson, in view of the control of the company having been acquired by Messrs. Brown Bayley's, the following new directors have been appointed:—Messrs. Robert Armitage (chairman), William James Armitage, Harry Brearley, Lord Ernest Hamilton, and Max R. Mainprice. The new directors, with the addition of the remaining directors, namely, Messrs. A. O. Peach, P. C. Low, E. S. Spyer, and Messrs. T. W. Cooper and F. C. Pryke—joint managing directors—constitute the new board.

CONTRACTS.

ROBERT STEPHENSON AND CO., Ltd., of Darlington, and 25, Victoria-street, Westminster, S.W. 1, have received orders from the Central Argentine Railway, Ltd., for ten compound superheater locomotives and tenders for goods traffic and ten boilers for the same class of engines.

THE Naval Construction Works of William Beardmore and Co., Ltd., at Dalmuir, have just received an order for the construction of a tug boat for the Compania Habanera de Vapores y Lanchas Havana, Cuba. The dimensions of the tug are 84ft. between perpendiculars by 20ft. 6in. by 10ft. 9in., and the propelling machinery will be manufactured and installed by the firm's Coatbridge works.

THE ENGLISH ELECTRIC COMPANY has received an order from the West Ham Corporation for a steam turbine-driven electric generator set of 30,000 kW capacity. The set, which will run at 3000 r.p.m., will have a single alternator and will constitute a record for machines of its type and speed. The same company has received from the Leicester Corporation an order for the construction of a 25,000-kW steam turbine and alternator, which will also run at 3000 r.p.m. The two orders include condensing plant in both cases, and, at Leicester, switchgear also.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., of Rugby, has received orders for the following plant required for the Sydney Suburban electrification scheme of the New South Wales Government Railways:—Sixteen single-phase transformers, each rated at 1100 kVA, and ten 1500-kW, 750-volt rotary converters, which will be connected two in series, so as to give 1500 volts. Some of the transformers will reduce pressure from 33,000 volts and others from 11,000 volts to a pressure which, applied to the rotary converters, will enable those machines to feed the track at 1500 volts. Among other orders received by the same company are one from the Calcutta Electric Supply Company for a 2500-kW, 6000/450 to 500-volt motor converter, with suitable starting equipment, and another for the complete electrical equipment for fifteen sub-stations, through which electricity for domestic and industrial purposes will be provided in Colombo, Ceylon.